Simplistic understandings of farmer motivations could undermine the environmental potential of the common agricultural policy

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Abstract

The European Union Common Agricultural Policy (CAP) has failed to achieve its aim of preserving European farmland biodiversity, despite massive investment in subsidies to incentivise environmentally-beneficial farming practices. This failure calls into question the design of the subsidy schemes, which are intended to either function as a safety net and make farming profitable or compensate farmers for costs and loss of income while undertaking environmental management. In this study, we assess whether the design of environmental subsidies payments in the CAP reflects current knowledge about farmers' decision-making as found in the research literature. We do so on the basis of a comprehensive literature review on farmers' uptake of agri-environmental management practices over the past 10 years and interviews specifically focused on Ecological Focus Areas with policy-makers, advisors and farmers in seven European countries. We find that economic and structural factors are the most commonly-identified determinants of farmers' adoption of environmental management practices in the literature and in interviews. However, the literature suggests that these are complemented by – and partially dependent on – a broad range of social, attitudinal and other contextual factors that are not recognised in interview responses or, potentially, in policy design. The relatively simplistic conceptualisation of farmer behaviour that underlies some aspects of policy design may hamper the effectiveness of environmental subsidies payments in the CAP by over-emphasising economic considerations, potentially corroding farmer attitudes to policy and environmental objectives. We conclude that an urgent redesign of agricultural subsidies is needed to better align them with the economic, social and environmental factors affecting farmer decision-making in a complex production climate, and therefore to maximise potential environmental benefits.

Keywords	Agri-environment; farmer decision-making; environmental payments; Ecological Focus Areas; Greening; Common Agricultural Policy
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Highlights

- We compare literature and interviews on farmers' decision-making
- Literature suggests a wide range of interacting factors affect farmer choices
- Policy-maker interviews reveal a narrow focus on economic and structural factors
- Simplistic design of environmental subsidies may limit uptake and effectiveness
- Better understanding of farmer motivations can help achieve environmental goals

Simplistic understandings of farmer motivations could undermine the environmental potential of the Common Agricultural Policy

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Simplistic understandings of farmer motivations could undermine the environmental potential of the Common Agricultural Policy

Abstract

The European Union Common Agricultural Policy (CAP) has failed to achieve its aim of preserving European farmland biodiversity, despite massive investment in subsidies to incentivise environmentally-beneficial farming practices. This failure calls into question the design of the subsidy schemes, which are intended to either function as a safety net and make farming profitable or compensate farmers for costs and loss of income while undertaking environmental management. In this study, we assess whether the design of environmental ~~subsidies~~ payments in the CAP reflects current knowledge about farmers' decision-making as found in the research literature. We do so on the basis of a comprehensive literature review on farmers' uptake of agri-environmental management practices over the past 10 years and interviews specifically focused on Ecological Focus Areas with policy-makers, advisors and farmers in seven European countries. We find that economic and structural factors are the most commonly-identified determinants of farmers' adoption of environmental management practices in the literature and in interviews. However, the literature suggests that these are complemented by – and partially dependent on – a broad range of social, attitudinal and other contextual factors that are not recognised in interview responses or, potentially, in policy design. The relatively simplistic conceptualisation of farmer behaviour that underlies some aspects of policy design may hamper the effectiveness of environmental ~~subsidies~~ payments in the CAP by over-emphasising economic considerations, potentially corroding farmer attitudes to policy and environmental objectives. We conclude that an urgent redesign of agricultural subsidies is needed to better align them with the economic, social and environmental factors affecting farmer decision-making in a complex production climate, and therefore to maximise potential environmental benefits.

Keywords

Agri-environment; farmer decision-making; ~~subsidies~~environmental payments; Ecological Focus Areas; Greening; Common Agricultural Policy

1. Introduction

In the 40 years since the European Union (EU) launched its legislative framework for environmental protection with the 1979 Birds Directive, levels of biodiversity have fallen sharply across the continent. By 2000, farmland species had lost a quarter of their 1970 populations in western Europe (De Heer et al., 2005), with closely-monitored farmland birds declining by around 50% - twice as fast as woodland birds (DEFRA, 2018; Donald et al., 2006; European Environment Agency, 2010; Pan European Common Bird Monitoring Scheme, 2019). Roughly three-quarters of farmland species and habitats had 'unfavourable' conservation status by 2010, meaning that they are at risk of extinction in the absence of management change (European Environment Agency, 2010). There is emerging evidence that insect biomass and abundance have declined rapidly in European agricultural land in the last few decades (Wagner, 2020). Alarmingly, biodiversity trends in the east of the continent have mirrored those in the west following the introduction of agricultural subsidies through the Common Agricultural Policy (CAP). For example, farmland bird species have declined by up to a third in the new EU member states (Reif and Vermouzek, 2019; Szép et al., 2014).

These declines have occurred despite an increasing proportion of the CAP's approximately €60 billion annual budget being earmarked to improve environmental outcomes, with €66 billion earmarked for this purpose during the current CAP period (2014-2020), in addition to other funds such as the estimated €5.8 billion spent each year on designating, protecting and managing Natura 2000 sites (European Commission, 2019a, 2016; European Court of Auditors, 2020). Agri-environmental schemes have been the main target of this funding, but the introduction of 'greening' measures in 2013 with a budget of approximately €12 billion per year (8% of the total EU budget) was intended to obligate all farmers to undertake environmentally-friendly farming activities on some of their land. However, the greening implementation required no management change whatsoever on 95% of EU farmland, and has consequently been described by the EU's independent external auditor as an environmentally ineffective income-support scheme (European Court of Auditors., 2017) in which environmental expenditure and impact have not even been reliably tracked (European Court of Auditors, 2020). In fact, literature suggests that the CAP as a whole has not only failed to prevent environmental damage, but has actively caused it by maintaining mechanisms that favour agricultural intensification (Reif and Vermouzek, 2019).

The failure of EU agricultural subsidies to achieve their environmental objectives is not due to a lack of knowledge about the adverse impacts of agricultural practices or the changes necessary to redress these. Numerous scientific studies have identified systemic changes and specific management practices necessary to better maintain biodiversity and protect the environment. Several of these management practices are already eligible for support under the CAP's greening programme (e.g. allowing land to lie fallow, incorporating some degree of agroforestry and maintaining field margins) (European Commission, 2017; Hart et al., 2017; Pe'er et al., 2017; Shackelford et al., 2017; Sutherland et al., 2018). However, their uptake has been limited, prompting considerable research into methods for improving rates of adoption (Brown et al., 2019; Díaz and Concepción, 2016; Navarro and López-Bao, 2018; Pe'er et al., 2019). A recent report by the European Environment Agency found that CAP interventions "have failed to deliver significant effects up to the scale and urgency of the challenges", necessitating a "fundamental sustainability transition" in the European food system (European Environment Agency, 2019). More than 3,600 scientists signed a recent

open letter calling for an urgent revision of the CAP to take these and other suggestions into account (Pe'er et al., 2020).

Ultimately, if attempts to improve the environmental outcomes of the CAP are to be effective, there must be greater uptake of environmentally-beneficial management practices by Europe's farmers. The rationale of European agri-environmental subsidies is to compensate farmers for lost income and additional costs, as well as to overcome perceived unwillingness to pursue environmental objectives (Batáry et al., 2015; de Snoo et al., 2013). However, recent reviews and meta-analyses suggest that European farmer decision-making is far more nuanced and diverse than this policy rationale implies (Bartkowski and Bartke, 2018; Brown et al., 2019; van Vliet et al., 2015). Failure to account for the array of farmer motivations may result in poorly-targeted incentives, reduced farmer uptake over time, and even distortions of those motivations if they encourage subsidy dependence over intrinsic determination (Herzon and Mikk, 2007; Kovacs, 2019).

In this study, we assess whether the design of environmental measures in the CAP reflects current knowledge about farmers' decision-making. We do so on the basis of a comprehensive review of literature dedicated to farmers' uptake of environmental management practices over the past 10 years and interviews with policy-makers, advisors and farmers in seven EU countries, focusing specifically on the Ecological Focus Area (EFA) scheme. EFA-related payments support farmers who adopt or maintain farming practices intended to help meet environmental and climate goals on arable land. As one of the mechanisms ~~Introduced~~ introduced under the CAP's Pillar 1 (direct payments; the other mechanisms being crop diversification and maintenance of permanent grassland), it involves different payment calculations and implementation rationale than agri-environment measures under the CAP's Pillar 2 (rural development), but requires Member States to ~~select~~ decide which ~~sets of~~ EFAs to make available to their farmers, and farmers themselves to choose among these.~~.~~ In the following section, we outline the development of the relevant agricultural policy at EU and national levels to elucidate the ways in which farmer choice is anticipated, and pre-empted, in available policy options. We then specify our review and interview methods, and proceed by analysing the motivations that have been found to govern farmers' decision-making in the previous and current CAP iterations (2007–2020), in comparison to current policy-makers' understandings of farmers' decision-making with respect to EFA options. We conclude with a reflection on the political, policy and environmental consequences of misunderstandings of farmer motivations for participation in environmental schemes, and their relevance for the current revisions of the CAP for 2021–2027 (European Commission, 2019a).

2. Background: Delineation and choice of agricultural 'greening' policy options between the Europe Union and Member States

The Ecological Focus Area (EFA) scheme, which is adopted as one focus of this study, forms part of the CAP's Pillar 1, and is a mandatory scheme in which farmers receive ~~subsidies~~ payments for selecting and implementing specified management options on arable land. EFAs are not the only environmental measures supported by the CAP, and so their development occurs within a broader framework of EU-funded agri-environment schemes (Batáry et al., 2015). Before individual farmers are given the opportunity to choose management options for implementing at farm level, these options are defined at European and national levels. The first step is a negotiation between the European Commission,

European Parliament and European Council, which determines the full range of available options under the CAP. Member States then select options offered to their farmers at national levels according to national priorities and context. The nationally selected options must finally be approved by the Commission and sometimes are negotiated further. This may result in national exemptions to the general rules.

During the negotiation of the most recent CAP reform (2013–2014), the European Commission proposed to link 30% of the direct ~~subsidies~~ payments (to which all farmers with over 1 hectare of land are eligible) to management practices that contribute to climate change mitigation and environmental protection, and to require the establishment of EFAs across 7% of each farm's area (European Commission, 2011a). This proposal was subsequently modified by the European Parliament to add a "green by definition" allowance for organic farms, to reduce the required EFA area to 3% of agricultural land (an area of 5% was ultimately agreed), to introduce "light-green" EFA options with fewer proven environmental benefits and to lower penalties for non-compliance. Finally, the European Council introduced 'catch and cover crops' as a further EFA option, supported higher flexibility for Member States regarding implementation and introduced further exemptions of farms from greening obligations (Brown et al., 2019). The above modifications lowered the environmental ambition of the greening, notwithstanding the existence of other forms of environmental payment (e.g. for Agri-environment-climate Measures (AECM), which can be complementary to greening measures but not double-funded as such).~~.~~

The process has been driven largely by agricultural and political interests. The European Parliament's Committee on Agriculture and Rural Development is a key negotiator in CAP reforms, and nearly a third of its members during the negotiation phase were either agricultural land-holders or members of farmer associations, suggesting substantial input from farming interests (Knops and Swinnen, 2014; Roederer-Rynning, 2015). The anticipated response of the farming community to the new legislation was also a key consideration for policy-makers, with costs and inconvenience to farmers, reductions in food production and threats to rural livelihoods among policy-makers' stated concerns about stronger EFA regulations (Hart and Baldock, 2011; Knops and Swinnen, 2014; Matthews, 2013). A subsequent review by the European Court of Auditors found that Member States selected EFA options to minimise burdens on farmers, even rejecting the evidence-based recommendations for ensuring environmental benefits that they had commissioned in the first place (European Court of Auditors, 2017).

In 13 Member States, six or fewer of the 18 possible EFA options were ultimately made available to farmers, with the most commonly-offered options those with the fewest environmental benefits (e.g. catch crops, nitrogen fixing crops and short rotation coppice) (Brown et al., 2019; European Commission, 2015; Underwood and Tucker, 2016). This generally resulted in 'menus' of options incapable of delivering meaningful environmental benefits (European Commission, 2017; European Court of Auditors., 2017; Pe'er et al., 2017), not least because they were poorly suited to the interests and needs of low-intensity farming environments and methods (Sutcliffe et al., 2015). The curtailment of EFA options also had the inevitable effect of limiting farmers' options for environmentally-beneficial land management.

3. Methods

We used two methods to gain insight into the factors that affect farmers' decision-making about environmental ~~subsidies~~payments. First, we undertook a review of scientific literature published between 2007 and 2019 to identify the factors that influence such decision-making. Second, we undertook interviews with national-level policy makers and advisors or farmers from seven EU Member States (Czechia, Finland, Germany, Greece, Hungary, Spain and Sweden; Table 1). We used the interviews to explain the selection of EFA management options that were offered by national governments to farmers, and the perceptions of farmer decision-making with respect to those options. We then compared the findings of these two steps to assess overlaps and mismatches between the design of EFA policy options and farmers' broad decision-making as portrayed in scientific literature.

In the interviews, we used EFA as a specific focus due to its recent implementation and the fact that, because it falls under Pillar 1 (as opposed to agri-environmental payments), most farmers had been exposed to it. This may limit the generality of interview results, and we adopted a broader focus in the literature review in order to capture a representative range of farmers' motivations and to explore how farmers deal overall with pro-environmental policy interventions. We addressed the partial mismatch between the literature review focus and that of the interviews by including questions to farmers and advisors also about broader agri-environment options, working with the existing limited research on greening and EFA, and considering the limitations in interpreting the results.

3.1. Literature review

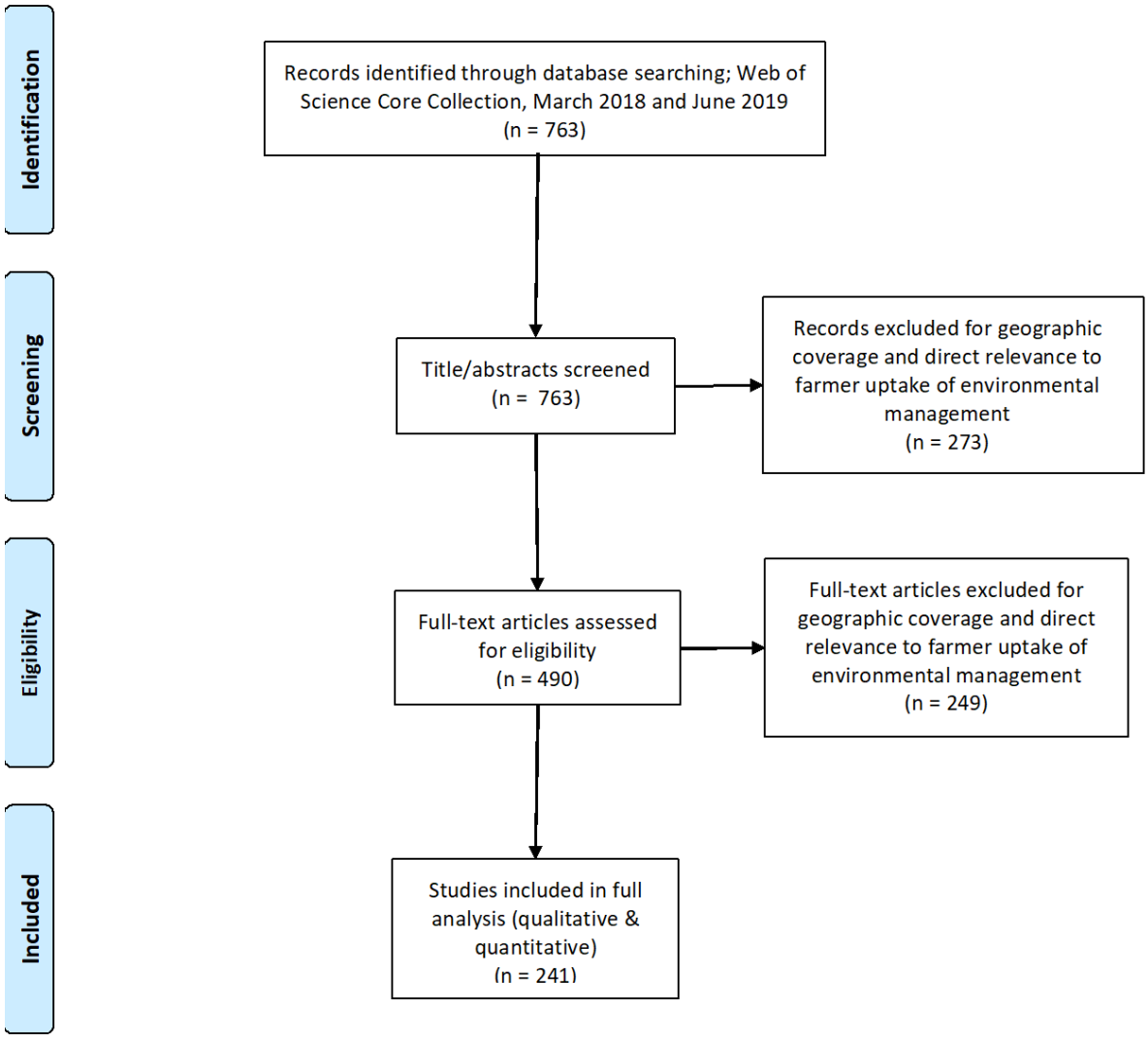
Our literature review took the form of a Rapid Evidence Assessment (Dicks et al., 2017) of academic titles to find all peer-reviewed articles dealing with farmer uptake of environmentally-focused management practices on farmland within the EU plus Switzerland and Norway. The latter countries were included in order to cover distinct regulative settings within a similar biophysical and socio-cultural context, consistently with comparable reviews such as Bartkowski & Bartke (2018). We limited the search to 2007–2019 to cover the previous (2007–2013) and current (2014–2020) CAP periods. Prior to the review, we identified papers of potential relevance to the topic based on our expertise in the field. This yielded a list of 22 papers published within the desired timeframe. We also used this initial list as a 'pilot' dataset to identify classes of factors that could be relevant in the final review. We searched in Web of Science Core Collection in March 2018 with the following terms: *(Agri-environmental OR agrienvironment OR agrienvironmental OR Agri-climate-environment OR agri-environment OR "ecological focus area*" OR "compulsory greening") AND (measure OR scheme OR program OR programme) AND (behaviour OR behavior OR attitude OR participation OR uptake OR compliance OR adoption OR choice OR decision* OR preference*))*. The search returned 642 papers, including 17 of the 22 papers suggested by members of the group (77% coverage of the suggested papers). The search was subsequently repeated in June 2019 to bring the assessment up to date, returning an additional 121 papers (763 in total) (Fig. 1).

We assessed the resulting papers in three consecutive stages. In the first stage we trimmed the papers using title and abstract, and in the second using their full text, on the basis of whether they dealt directly with farmer uptake of environmentally-relevant practices within the study region (EU-28 + 2 (Switzerland and Norway)). These exclusion steps were subject to random cross-checking by different members of the author team, with at least 2 excluded papers from each reviewer being independently checked. No disagreements were found. Following these steps, we retained 241 papers (208 from the original review and 33 from the updated 2019 review) for further analysis. In the third step, these papers were distributed among 11 reviewers who read and extracted information from their designated papers according to a review

spreadsheet designed to capture the factors identified from the original 22 suggested papers, as well as a range of contextual information (coding categories are available in Appendix 1). For each factor, we recorded the reported existence, direction and approximate strength of its effect on uptake of environmental measures, on a (-2 to 2) scale (i.e. so that weak and strong effects, both positive and negative, could be recorded as well as instances of 'no effect'). Each reviewer also cross-checked two randomly-selected papers first reviewed by other reviewers, finding no substantive differences.

In presenting the results of the literature review below, we use few quantitative summaries because of the difficulty of disentangling reported findings from research assumptions, methods, or survey questions across the literature as a whole. This difficulty is apparent, for instance, in the relative dominance of research on the economic aspects of farm management, and the relative paucity of research on social aspects (similar to Dessart et al., 2019). Furthermore, quantitative summaries of an earlier iteration of the literature review used here are presented in Brown et al. (2019), and the results below build on and extend these summaries where relevant. We also checked for biases in the evidence base from different interview sample sizes, and from different methods and geographical foci in the literature, by analysing sub-sets of the results. Nevertheless, the review remains non-exhaustive and complements other recent reviews based on distinct but mutually intersecting samples (e.g. Bartkowski and Bartke, 2018; Dessart et al., 2019). We therefore highlight any mismatches between our findings and these other reviews below.

Figure 1: Summary of Rapid Evidence Assessment literature review based on the standardised flow chart of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher et al., 2009)



3.2. Interviews

We carried out semi-structured interviews with two groups of interviewees: national-level decision-makers and advisors or farmers. National-level decision-makers worked with the relevant agricultural Ministry in each country and were involved either in European-level negotiations or national decision-making processes (Table 1). We asked them about the decision-making process behind the national-level selection of EFA measures, the actor composition of decision-making bodies, as well as the reasons why particularly effective environmental measures were or were not included in the national EFA portfolio of their

285 country. We also asked about their perceptions of farmers' reasons for adopting or~~f~~ not
286 adopting particular EFA measures (see Appendix 2 for interview guidelines).

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289 We also interviewed advisors and farmers to explore perceptions of farmer motivations in
290 choosing among the EFA options, as well as among other agri-environmental options. The
291 interviews consisted of three parts (Appendix 2). In the first, we asked open questions about
292 farmers' motivations for adopting environmental measures. In the second, we asked
293 structured questions about specific possible determinants of adoption or non-adoption, and in
294 the third we asked interviewees to assess the validity of several hypotheses derived from the
295 literature review.

296 In both interview groups, responses were transcribed before being categorised and coded for
297 themes and variation around set questions. Advisor and farmer interviews were designed to
298 ensure that factors identified in the literature review would be touched upon, but with
299 additional flexibility to allow questions to be tailored to each country's socio-economic,
300 biogeographic and administrative context. Interviewees were chosen for their experience in
301 the CAP system and knowledge of the agricultural sector within their country, and were
302 generally farm advisors or farmer extension service personnel. The numbers and backgrounds
303 of all interviewees are given in Table 1, and interview guidelines and questions are available
304 in Appendix 2. Interview numbers in each country depended upon availability of
305 interviewees and interviewers, and were not intended to identify 'representative' national
306 views but to illustrate particular viewpoints. Comparisons were made within and between
307 countries to avoid bias in the results due to different numbers of interviews (which varied
308 between 3 and 13).

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Table 1: Summary of the national-level and advisor and farmer-level interviewees. For complete details see Brown et al. (2019). Decision-maker interviews were not conducted in Spain due to time and resource constraints, while bias from the relatively large sample size in Finland was checked for in the analysis.

Country	No. interviews with decision-makers	Decision-maker interviewee background(s)	No. interviews with advisors and farmers	Advisor and farmer interviewee background(s)
Czechia	1	Ministry of Agriculture	3	Association of Private Farms and Association of Young Farmers
Finland	1	Ministry of Agriculture and Forestry	13	Metsähallitus (state owned, responsible for 1/3 of Finland's surface area); Centre for Economic Development, Transport and the Environment; active farmers; Rural advisory services
Germany	1	Ministry for Agriculture	3	Active farmers and local nature conservation agency
Greece	1	Ministry of Rural Development and Food	3	Farmers and agronomists (representatives of farmers' associations and of the public sector on EU-funded programmes)
Hungary	1	Hungarian Ministry for Agriculture and Rural Development	3	Farm administrators from the National Chamber for Agriculture (NAK)
Spain	0		6	Regional chapter of farmer associations and cooperatives in Aragon and Navarre, and farm advisors
Sweden	1	Ministry for Agriculture	4	Regional and local chapter of farmer associations (Skåne and Östergötland)

4. Results

4.1. Overview

Our review incorporated a large body of literature, while our interview data are derived from a relatively small sample. The literature and the interviews were also unevenly and differently distributed across countries, with the literature mainly dealing with western Europe (see Brown et al. (2019) and also the similar finding of Bartkowski & Bartke (2018)) and the interviews being restricted to just seven countries (Table 1). Comparisons between the two are therefore of limited rigour, and we consider their consistency with broader literature in the Discussion section. In addition, our interviews mainly focused on EFA measures while our review included

broader agri-environment interventions to capture a full range of farmer motivations. Notwithstanding these caveats, we discovered a similarity of views held by national-level policy-makers and advisors and farmers across our investigated case study countries, and that these views did not accord well with the array of farmer motivations as investigated and demonstrated by the literature (Table 2). This is particularly striking given that advisors and farmers were actually prompted to consider these different factors, and actively dismissed several of those highlighted in the literature.

Differences between assumed and literature-based motivations were fewest and smallest for economic factors, and advisors and farmers were slightly better aligned with farmer decision-making than were national decision-makers, but many areas of significant misalignment remained. In particular, the spread and dependencies of factors influencing farmer decision-making in the literature were far greater than was recognised in either national decision-making or advisor and farmer interpretations. Instead, interviewees predominantly supplied a relatively simplistic and homogeneous image of governments and farmers selecting EFA management options that provided the greatest economic benefits (and smallest costs), consistent with economic 'rational individualised self-interest' assumptions that have a long history in agriculture (Lipion, 1968; Vanclay and Lawrence, 1994). The more comprehensive literature on farmer decision-making, in contrast, suggested that farmers were influenced by a range of economic, social and attitudinal factors, with highly context-dependent effects that involved trade-offs between different objectives. In the following, literature findings are explored with some comparison to interview material within broad emergent factor groups (Table 2).

Factors		**Farmer behaviour (literature)**	**Advisor and farmer views (interviews)**	**National decision-maker (interviews)**
Economic	Benefits			
	Costs			
Socio-demographic	Experience			
	Education			
	Age			
Farm structure	Consistency with farm activities			
	Size			
	Tenure			
	Productivity			
Farmer beliefs & values	Productivist motivation			
	Environmentalist motivation			
	Societally oriented motivations			
	Social openness, trust & networks			
Policy design	Complexity			
	Flexibility			
	Coherence with other policies			
	Perceived legitimacy			
Environmental	Direct benefits			
	Indirect benefits			

Table 2: The importance of different groups of factors to farmer decision-making as revealed in the literature, the perceived importance of those factors among advisors and farmers, and the importance given to them in national-level selection of management options to offer to farmers. The intensity of the shading indicates the importance of these effects, with importance assigned according to the number of times each factor group was identified and the strength attributed to it in interviews or literature (white = not mentioned or no importance, lightest shade = mentioned in up to ca. 1/3rd of cases or predominantly given low importance, middle shade = mentioned in up to ca. 2/3rds of cases or predominantly given mid or mixed importance, darkest shade = mentioned in more than ca. 2/3rds of cases or predominantly given high importance). We explore the specific meanings and realisations of the factors in the text, and further details of these and more detailed sub-factors are provided in Brown et al. (2019). The reviews of Bartkowski & Bartke (2018) and Dessart et al. (2019) also provide complementary results using overlapping but distinct categories and sub-categories.

Our checks for differences across the literature related to methods or geographical foci showed limited variation. Our inclusion of Norway and Switzerland alongside the EU member states did not reveal large differences in decision-making in these different contexts: only two papers dealt with Norway ~~but~~ while the 11 papers dealing with Switzerland were reasonably consistent with the broader literature. In them, slightly less importance was attributed to structural and socio-demographic factors and slightly more to environmental and farmer-values-related factors. Further work is required to assess whether these are meaningful differences, along with the implications of the strong west-European bias in the literature. We also removed 14 literature reviews from our sample (to check for any effect of double-counting and possible bias) and found these to be very consistent with the overall results, with only slightly less reporting of financial factors. However, we also found that studies based on statistical analysis ~~or modelling of empirical data had slight tendencies to over-~~tended to ~~emphasise~~highlight~~s~~ structural factors more than the rest of the literature, and those based on modelling of empirical data tended to highlight ~~and~~ economic factors~~, respectively, relative to the rest of the literature~~. Interestingly, five papers that surveyed experts on farmer decision-making produced a similarly limited range of factors as our own interviews did, contrasting sharply with the rest of the literature.

4.2. Economic Factors

Economic factors were the most commonly-referenced group in the literature as well as interviews. In the literature, we found thirty papers that identified higher payments as being central to farmer uptake, with direct positive relationships shown, for example, in Germany (Bock et al., 2013), Italy (Borsotto et al., 2008), Ireland (Di Falco and van Rensburg, 2008) and EU-wide (Ruto and Garrod, 2009). Extra 'bonus' payments for longer contracts or other features were found to lead to higher uptake in Spain (Alló et al., 2015) and France (Kuhfuss et al., 2016; Le Coent et al., 2017). A key feature of such payments was that they should go beyond recompense for implementation or opportunity costs. Furthermore, Prager and Posthumus (2011) reported that compensation for such costs should also account for the need to learn new skills, and that payments may additionally need to overcome lower levels of satisfaction and higher levels of uncertainty associated with less intensive land management. For some farmers, implementation was perceived as increasing economic diversity and resilience (Dörschner and Musshoff, 2013; Mouysset et al., 2013). Conversely, the fear of sanctions for poor performance was identified as a barrier to uptake in some cases (Kovács, 2015; Prazan and Theesfeld, 2014; Zinngrebe et al., 2017). More generally, interaction between economic and other factor considerations was repeatedly highlighted in the literature as tempering 'simple' economic rationality. Social, structural or environmental characteristics

were identified as relevant (e.g. in the importance to farmers of maintaining traditional modes of production), and capable of altering economic responses to policy options (Hammes et al., 2016).

In national-level interviews~~,~~ direct financial benefits to farmers were consistently highlighted as crucial to the selection of EFA options (and were also seen as beneficial to the state through increased electoral support, particularly in eastern European countries where rural voting populations remain higher than in western Europe). This similarity occurred despite some of the factors identified in the literature having limited relevance to a compulsory scheme such as EFA. For example, our Hungarian interviewee stated that the government's motivation was to "make the most amount of money and options available to Hungarian farmers" and "to provide farmers with the largest range of options possible, so that they could get the most out of the direct payments of the CAP". This sentiment was explicitly echoed by the interviewees from Czechia and Greece, who suggested that a major consideration in the choice of EFAs was the benefits that producers would receive. No relationships between economic and other types of factor were cited. ~~These results may be specific to EFAs, but i~~It is notable that none of our interviewees suggested ~~so~~that different motivations were at play in broader agri-environment schemes, ~~and advisors and farmers did not~~ even, in the case of advisors and farmers, when asked specifically about this. ~~when asked about broader agri-environment schemes.~~

Advisors and farmers also identified higher payment rates as being of primary, and independent, motivational importance for farmer choices (Germany, Hungary, Finland, Sweden, Czechia, Greece). Spanish and Hungarian interviewees suggested that policy-makers did not fully appreciate the need for farmers to financially sustain their businesses. Associated with this was the recognised need for farmers to overcome implementation and opportunity costs involved in some environmental measures like the management of landscape elements (e.g. hedges, trees or terraces). Several interviewees expressed dissatisfaction with current payment rates for landscape elements, buffer strips and fallow land (Germany, Sweden, Finland, Germany, Hungary), and with the 'one-size-fits-all' nature of these payments, which fails to account for dependencies on local conditions such as soil quality (Czechia). These inconsistencies with local practices or conditions were not mentioned by national government-level interviewees as a consideration.

4.3. Socio-demographic factors

Socio-demographic factors were frequently identified in the literature as affecting farmers' participation in environmental measures in general (though causative or explanatory linkages between socio-demographic factors and behaviour were rarely investigated). The clearest relationships in this category concerned the effects of knowledge or experience of particular management options, and general education levels, both of which were strongly associated with uptake (Lastra-Bravo et al., 2015; Micha et al., 2015; Siebert et al., 2010) and even with ultimate environmental impact (McCracken et al., 2015). However, evidence about the effects of farmer age was contradictory, even within the same countries. While younger farmers were sometimes found to be more open, able or willing to experiment with new management options, other studies reported that uptake was higher amongst older farmers (Arata and Sckokai, 2016; Lastra-Bravo et al., 2015) (the effects of farmer age were found to be slightly stronger in the review of Bartkowski & Bartke (2018)). Similarly, part-time farmers may be the most likely to adopt measures (van Vliet et al., 2015; Vesterager and Lindegaard, 2012), or the least likely (Mante and Gerowitt, 2009; Matzdorf and Lorenz, 2010). We also found

two studies that investigated differences in uptake between male and female farmers (in Spain and Sweden), both of which concluded that adoption rates were lower among female farmers (Franzén et al., 2016; Špur et al., 2018), though in one case a link to different knowledge levels was posited (Špur et al., 2018) (the review of Bartkowski and Bartke, 2018 found eight additional studies with mixed results about different behaviour among male and female farmers). In our interviews, in contrast, socio-demographic characteristics were not raised by national-level interviewees, and advisors and farmers only identified previous experience with conservation measures and knowledge of biodiversity as important to farmers applying to participate in environmental schemes. In this case, the distinction between the mandatory EFA and optional agri-environment schemes may provide an explanation, albeit one that was again not raised by interviewees.

4.4. Farm structural factors

Various structural factors were highlighted in the literature. Preferences for implementing environmental measures on marginal (including mountainous areas and islands), extensive, organic or otherwise less productive land were frequently identified, and sometimes linked to the lack of additional work required for implementation – in some cases undermining the additionality of those measures relative to prior management (e.g.Borsotto et al., 2008; Van Herzele et al., 2013; Zinngrebe et al., 2017). Effects of other factors were less clear-cut. For instance, similar numbers of studies found that measures were more likely to be taken up by small farms (Aslam et al., 2017; Pascucci et al., 2013; Walder and Kantelhardt, 2018) as by large farms (Grammatikopoulou et al., 2013; Ruto and Garrod, 2009; Zimmermann and Britz, 2016), and by non-production-oriented or less profitable farms (Breustedt et al., 2013; Micha et al., 2015; Ruto and Garrod, 2009) as by professional or full time farmers (Gatto et al., 2019; Matzdorf and Lorenz, 2010; Pascucci et al., 2013).

These nuances were not reflected in our interview findings, ~~but other factors were more strongly emphasised~~to some extent reflecting the specific nature of EFAs, which are by definition only applicable only to arable land. In national-level interviews, the consistency of subsidised management options with existing practices, landscape features or policies was the most frequently identified factor of any category (notably, the review of Bartkowski & Bartke (2018) also found this as being strongly important from their literature sample, ~~to some extent along~~ with farm size slightly less so). Interviewees from Hungary, Czechia, Germany and Sweden identified this as important; in Hungary payments for stone walls were not offered as these were not typical features of Hungarian landscapes, and in Czechia hedges, field margins and buffer strips were additionally excluded as being atypical and 'untraditional'. Other measures such as agroforestry were considered irrelevant in a number of countries (Sweden, Hungary, Finland, Czechia). Farmer representatives also emphasised the importance of existing practices in determining the selection of management options, but went beyond this to identify farm size, land productivity and tenure as extra factors. Tendencies were identified for greater uptake among farmers with large farms or marginal land, both of which minimise the scale of change and risk involved in implementation. Conversely, tenure insecurity was thought to reduce the likelihood of uptake, a finding of great relevance amongst trends of increasing levels of tenancy throughout Europe. Advisors and farmers also argued that payments should be reserved for professional or full-time farmers, who rely on their farming income and therefore may be less likely to adopt measures with unknown impacts.

4.5. Farmer beliefs and values

In the literature, a wide range of beliefs and values are shown to play a role in determining farmer engagement. In particular, strong positive correlations exist between pro-environmental attitudes and participation in biodiversity schemes, and negative correlations between productivist (or traditionalist) attitudes and participation (Breustedt et al., 2013; Espinosa-Goded et al., 2013; Grammatikopoulou et al., 2013; Kvakkestad et al., 2015; Micha et al., 2015). Beyond these, specific characteristics increasing farmers' openness and societal-identity (i.e. farmers perceiving their role in wider society as important) were found to correlate positively with participation (de Krom, 2017; Gabel et al., 2018). This link may also contribute to the tendency for farmers with strong social networks and vertical capital, social trust or neighbourly relations, to participate (Alló et al., 2015). In fact, such social connectedness may also lead to changes in farmers' attitudes or values, and therefore their willingness to adopt particular management practices, highlighting the dynamic social nature of this group of factors (Rose et al., 2018; Siebert et al., 2006).

In contrast to the literature, our national interviewees only referred to farmers' beliefs and values in terms of supposed 'productivism', by which they meant that farmers select schemes that allow them to maximise income and productivity. This was used by a number of interviewees to explain the widespread selection of nitrogen-fixing crops, cover crops and fallows, in particular. This productivist narrative was also apparent among advisors and farmers: "farmers see themselves as producers, not as stewards of nature" (Spain). This group also recognised the existence of other perspectives, however, suggesting that some farmers held pro-environment values and felt responsible for "environmental stewardship", future generations and sustainability, all of which increased the likelihood of biodiversity measure uptake. A number of interviewees expressly lamented the absence of "a broader discussion on the role of agriculture and food production in society" (Sweden), and the benefits of certain management practices in particular societal contexts (Germany, Spain).

4.6. Policy design

Issues of legitimacy were particularly apparent in the literature concerning policy design. In Hungary, farmers perceived political bias in the state's monitoring and auditing requirements (e.g. Kovács, 2015), and in Greece prior negative experiences with state actors, or perceptions of corruption, made farmers unwilling to engage with policy schemes, especially where external oversight of farm affairs was necessary (Micha et al., 2015). Policy complexity, inflexibility and administrative burdens were identified in the literature as barriers to uptake across Europe (Zinngrebe et al., 2017, Ruto and Garrod, 2009). Specific factors included excessive time and labour requirements (EU-wide; Lastra-Bravo et al., 2015) and the inability of farmers to pay for consultants (in Hungary; Kovács, 2015). These problems were seen as surmountable, however, through appropriate design of the implementation process. In Austria, the greatest conservation efforts and ecological benefits were achieved via compromise-oriented implementation methods in which trade-offs between farmer preferences were formalised and accepted (Geitzenauer et al., 2016).

The complexity of EFA policy design was also a major factor identified by national-level interviews as affecting the capacity of government institutions as well as individual farmers. In this case, of course, participation is compulsory and so farmers to do not have the option of entirely avoiding the administrative burden. Nevertheless, ~~. For example,~~ measure selection was said to be determined by the ease of any monitoring required by state agencies to ensure

compliance. Further specific examples included the prohibitively high costs of mapping watercourses in Finland, and a lack of institutional access to maps and poor communication channels between Hungarian water authorities and agricultural offices. Greek and Finnish interviewees further suggested that there was a determining role in the need to keep administrative costs low for both state agencies and farmers. Similarly, the extent of flexibility in policy design was viewed as important, as it allowed requirements to be adjusted to institutional and local contexts. Even in the absence of flexibility, complementarity with other policies (national policies beyond the CAP) influenced political decisions at the national level (Sweden, Finland, Greece, Czechia).

Advisors and farmers likewise regarded complexity as negatively influencing uptake, but suggested that specific measures such as improved training, registration and technical assistance (e.g. with high precision mapping) could help to offset this effect (Germany, Hungary, Finland, Sweden, Czechia, Greece). Empowering farmers in this way could reduce barriers to uptake (Greece), but could also reduce the control of government agencies and consultants, making outcomes "less dependent on the attitude of the auditor" (Hungary). As a Spanish interviewee said, "the fact that the implementation of the measures is very complex needs to be reviewed to make them more 'friendly' to the producers", especially in terms of reducing bureaucracy so that farmers can be "near their land rather than filling in papers". Again, flexibility was identified as a key component to improving uptake, for instance through potential adjustments to local contexts (Czechia, Spain). Administrative burdens, monitoring and the threat of sanctions were seen as undesirable (Greece, Sweden, Germany), and voluntary measures or those consistent with other policies were generally seen as preferable. However, a counterpoint was provided by some advisors and farmers who identified a tendency to accept greater regulation where it is associated with greater political legitimacy. For example, interviewees alluded to farmer preferences for "regulation and higher resulting prices instead of receiving subsidies", and suggested "farmers are sick of having to sell their products at low costs and then be implicitly compensated with 'green' payments. They would rather have their products better paid in the market, even if under stricter environmental requirements" (Spain). The tendency for the largest and most intensive farms to receive the greatest subsidies was identified as one perceived indication of policy illegitimacy.

4.7. Environmental factors

In the literature, direct and indirect environmental benefits were identified by a minority of papers. In general, positive environmental attitudes were found to be correlated with uptake in general (see above), as were specific perceptions of environmental degradation or a need for environmental protection (Barreiro-Hurlé et al., 2010; Emery and Franks, 2012). In some cases, perceived benefits included safeguarding particular species or habitats (Dutton et al., 2008; Saxby et al., 2018). Further effects are hinted at by correlations between environmentally valuable areas, grasslands or diverse landscapes and increased uptake of environmental management options among farmers (e.g. Espinosa-Goded et al., 2010; Grammatikopoulou et al., 2013; Hammes et al., 2016; Hynes et al., 2008; Mante and Gerowitt, 2009; Matzdorf and Lorenz, 2010). Indirect benefits were also identified; for example in Poland a majority of surveyed farmers expected productivity gains from the application of environmental measures (Świtek and Sawinska, 2017).

At national decision-making levels, ecological factors were not identified as playing a direct role (with the exception of a German interviewee's claim that measures were selected "in the

interest of sustainable agriculture"). Specific indirect benefits were identified in Finland and Sweden, where nitrogen-fixing crops were seen as reducing the need for mineral fertilisers and energy for their production, and imported protein crops and the associated deforestation in South America. Advisors and farmers also made few references to ecological factors, but did imply some environmental motivations amongst farmers by suggesting that the environmental benefits of management options should be better demonstrated and rewarded to encourage uptake (Germany, Greece, Spain).

5. Discussion

Our literature review of a decade's worth of academic research on farmer motivations in adopting environmental subsidies or payments revealed a wide range of context- and inter-dependent factors. The results from our small number of interviews with policy-makers and advisors and farmers from across the EU were to some extent consistent with the literature, but also suggested interesting mismatches between research and interviewee's perceptions. This mismatch may partly stem from the sample size differences and the interviews' focus on EFAs. However, the consistency of responses within and across different states, and their resemblance to previous findings (discussed below) suggest the existence of notable misconceptions about farmer decision-making among actors involved in policy-making. That these consistencies emerge despite the policy-maker and advisor and farmer interviews having somewhat different designs also adds weight to their interpretation as meaningful. That said, we first deal with limitations of our study before going on to a broader discussion of our findings.

Limitations

Our literature review was not fully systematic and missed some papers known by the authors to be relevant. Other recent reviews (e.g. Bartkowski and Bartke, 2018; Burton, 2014; Dessart et al., (2019) and (Bartkowski and Bartke, (2018) therefore provide important complementary findings, some of which are more specific and include alternative categorisations. Meanwhile Burton (2014) (not captured by our literature search) goes into substantially more detail about farmer demographic characteristics and their influence on environmental behaviour (e.g. with respect to farmer gender, which is a minor factor in the literature we reviewed).

The literature is not entirely clear-cut about some points. For instance, structural factors such as farm size are reported to have positive, negative or neutral associations with environmental management. Other research suggests that this is because these are not reliably associated with motivational factors that determine uptake (Wuepper et al., 2020). Even strong and apparently reliable effects can obscure considerable variation. For example, tenure arrangements can vary greatly between countries, altering the importance of tenure for farmer decision-making: Leonhardt et al. (2019) show that relatively secure tenure in Austria means that farm ownership has strictly limited effects. In addition, factors such as these that play

some role in voluntary uptake of environmental management are unlikely to play the same role in compulsory engagement with EFA options.

We also find that research methodologies can influence findings, and noted during our review that incomplete descriptions of these methodologies hamper interpretation. For instance, aggregated results hide the fact that studies of farmer decision-making are designed to find effects of economic factors far more often than ecological or social factors, and that 'negative' findings (i.e. that particular factors have no effects) are not often reported (but see Bartkowski and Bartke, 2018; Brown et al., 2019). Such biases can be further formalised by modelling approaches common in the literature that treat farmer decision-making as a predictable response to economic stimuli (Brown et al., 2017; Nilsson et al., 2019). We do not attempt to fully assess these potential biases here, but note that qualitative distortion of findings because of methodological biases appears to be unlikely, on the basis of our own and others' reviews.

Interviews introduce further uncertainties. For example, the existence of fallow land was seen by our interviewees as according with a productivist perspective, while the literature suggested that farmers can perceive it as contrary to productivist practices (Tarjuelo et al., 2020). We also had one interviewee who was associated with an environmental organisation, potentially introducing a different perspective that is impossible to distinguish within such a small sample. Most importantly, our interviews primarily focused on EFA measures (only advisors and farmers were asked about agri-environment measures more broadly; Appendix 2). While this provided a common ground to compare the interview findings across the countries (a mandatory scheme that is nevertheless implemented in different forms across the countries), it also limited the scope for comparisons between interviews and literature findings. Both our interviews and results from literature (especially that based on expert interviews) suggest that such comparison is nonetheless valid, with no distinctions drawn between motivations underlying the two policy types. While EFAs are mandatory, specific measures are selected at national level with some consideration of farmer motivations, following which farmers themselves choose between those measures. This gives some relevance to evidence about choices among fully voluntary measures, if not their initial uptake. Nevertheless, there remains clear scope for different motivations to affect responses to different types of policy in ways that are not captured by our interviews or the literature we reviewed, and for the literature evidence relating to non-arable agricultural land to be inapplicable to EFAs. In the following discussion we remain alert to the fact that interviews focused on a more specific policy tool while most of the literature addresses environmental interventions on farmland more broadly.

Findings

At a general level, interviewed policy-makers and advisors and farmers held relatively homogenous and simplistic perceptions of the factors affecting farmer decisions as being predominantly based on rational, economic cost-benefit considerations. These perceptions are consistent with the findings of previous studies that identify a disproportionate emphasis on economic factors (e.g. Burton and Paragahawewa, 2011; Dessart et al., 2019; de Snoo et al., 2013; Zinngrebe et al., 2017). This emphasis has strongly influenced national-level policy discussions about which measures to make available to farmers, alongside concerns raised in our interviews about landscape relevance and administrative burdens. The preclusion of EFA options thought to be too burdensome, costly or unpopular continues a long-standing tendency for the CAP to be tailored to the perceived 'convenience' of productivist farmers (Hart, 2015; Nilsson et al., 2019; Pe'er et al., 2017; Poláková et al., 2011). The Commission's

own 2011 Impact Assessment and other reports warned against such "watering down" because it inevitably favours options compatible with intensive agriculture and fails to significantly benefit farmland biodiversity (European Commission, 2017, 2011b; European Court of Auditors., 2017; Pe'er et al., 2017; Sutcliffe et al., 2015). While it is possible that interviewees did not mention environmental factors while discussing EFAs due to the mandatory nature of that scheme, it is notable that they almost universally mentioned purely productivist attitudes and even explicitly rejected environmentalist attitudes in some cases, ~~as intrinsic rather than~~and did not identify either as purely policy-related characteristics.

It is true that many farmers focus on agricultural production and are unable or unwilling to forego part of their income in order to implement environmental measures (Wilson, 2001). However, even the most profit-oriented farmers are willing to ~~forego~~ lose some income in order to implement measures that allow diversification, utilise marginal land or otherwise reduce risk; all of which actually constitute economically rational choices (Lienhoop and Brouwer, 2015). The literature also suggests that many famers have supra-economic motivations that can prompt choices to improve environmental conditions even at financial cost (Hammes et al., 2016). The excessive simplicity of profit maximisation as a guide to behaviour is well-recognised in agricultural economics, suggesting that our interviewees' responses are based not on economic perspectives per se but on very limited interpretation of economic rationality (Weersink and Fulton, 2020). This lack of nuance goes unrecognised among policy-makers, suggesting that opportunities to develop measures that target different agricultural, social, cultural and ecological contexts could be missed. This may go some way to explaining why current efforts to decentralise competencies into EU member states have contributed to unintended homogenisation and intensification, as different countries have tended to select the same EFA options that maximise revenue and production (Pe'er et al., 2020, 2017).

There is also evidence that skewed political perspectives cause damage not only of omission but of commission. Subsidies, and the narratives that underpin them, can alter farmers' own perceptions and work practices over time (Kovacs, 2019); an example of 'adaptive preferences' that shape themselves to – and positively reinforce – available options (Elster, 1983; Sen, 2001). In this way, a productivist ethos has to some extent been imposed on farmers by decades of production-oriented ~~subsidies~~ payments (Burton, 2004a; Erjavec and Erjavec, 2015; Wilson, 2001). Not only can this reduce the strength of farmers' intrinsic environmental values (Silvasti, 2003), but the remaining tension between imposed and intrinsic motivations can engender cynicism and resistance, with the consequence that some farmers regard agri-environment schemes as illegitimate (Walder and Kantelhardt, 2018). Similar views are held by farmers concerned about political corruption or the ineffectiveness of environmental ~~subsidies~~ payments (Micha et al., 2015; Nilsson et al., 2019). For these farmers, transparent and fair support for measurable environmental benefits is crucial, and would even justify trade-offs with other objectives (Broch and Vedel, 2012; Velten et al., 2018).

The scope for change in decision factors and motivations can also be positive, and need not result solely from policy pressures. The literature shows that considerable influence is exerted by the social networks in which farmers are embedded, in particular neighbours and other trusted sources of information that farmers often rely on more than governmental or 'independent' sources (Brown et al., 2018; Rose et al., 2018). Increasing the understanding, appreciation and support for environmentally-beneficial management practices in these social networks could be far more effective than policy interventions alone (Burton and

Paragahawewa, 2011; de Snoo et al., 2013). In particular, socially-embedded change has been shown to reduce the perceived risks of new management practices (Oreszczyn et al., 2010), support collaborative 'landscape-scale' schemes (Emery and Franks, 2012) and legitimise results-based payments (Herzon et al., 2018). Such an approach can also account for contextual relations and levels of trust in formal or state institutions. Broader social change can also affect the agricultural practices associated with particular regions, cultures or traditions, but may be inhibited by the exclusion of options at national level for their inconsistency with traditional land uses (Jones, 1991; Markuszewska, 2019; Solymosi, 2011). This may imply a role for 'centralised flexibility' that enables decentralisation while also guaranteeing scope for adaptations at local scales – or, as Pe'er et al. (2020) suggest, local experimentation within a rigorous EU-wide monitoring and payment framework.

Utilising the diversity of farmer motivations for positive environmental change requires a high level of knowledge transfer between farmers, extension services, social scientists and policy-makers (Broch and Vedel, 2012; Burton, 2004b; Feola et al., 2015; Knierim et al., 2017). Existing examples of successful agri-environment scheme design and implementation can provide useful guidance. In fact, reviews have found that many nuances can be distilled into a few key design principles: having highly targeted, specific aims; participatory policy design with local stakeholders; and simple implementation supported by trusted advice (Blumentrath et al., 2014; Meyer et al., 2015; Toderi et al., 2017). Our review and interviews find limited further evidence of these principles being used in the development of EFA and broader CAP agri-environment schemes. It is therefore crucial that policy is designed to account for the effects of factors such as ecological motivations, farm size, farmer age, or domestic and landscape-level diversity and governance arrangements on farmer decision-making, as individual characteristics and as interacting elements of decision contexts. ~~If t~~The mandatory, constrained nature of EFAs (or potential 'eco-schemes' in the post-2020 CAP) and the apparent lack of consideration of a realistic range of farmer characteristics ~~makes any of these factors less relevant to farmer decision-making, it~~ compromises the potential of the scheme to ~~make a positive environmental impact, and highlights the need for the CAP to be reshaped to the wide~~capitalise on the diversity of farmers and environments that exist in Europe.

6. Conclusion

Reforms of the Common Agricultural Policy have not effectively utilised extensive scientific knowledge about socio-ecological interactions at farm level, and have failed to produce environmental benefits. As the European Environment Agency recently concluded, there is a need for "urgent systemic solutions" involving "a rapid and fundamental shift in the character and ambition of Europe's responses" to biodiversity losses (European Environment Agency, 2019). This paper examined, through a wide-ranging literature review, the factors that influence farmers' willingness and motivation to participate in measures known to be beneficial for biodiversity, and the perceptions of these factors among national-level policy-makers and farmer representatives from around Europe. We found that the most commonly-researched and recognised factors (relating to economic and structural characteristics) influence farmers in varied, context-specific ways. These nuances in factor effects were not reflected in our interview responses, adding weight to other findings that policy is often made on the basis of a simplistic conceptualisation of farmer behaviour that unduly emphasises the importance and independence of crude economic considerations. Clear demonstration of

environmental benefits could have substantial benefits, capitalising on farmers' motivations to improve environmental outcomes and counteracting a lack of trust in policy purposes and efficacies. Similarly, appropriate opportunities for training, education and participation in policy design, and a communication framework based on social networks rather than government agencies would further redress the counterproductive simplicity of current policy. These changes are not simple, but they have widespread support in farming, scientific and political communities (Pe'er et al., 2020) and would replace a notably unpopular status quo (Velten et al., 2018). In the absence of such reform, ever-decreasing levels of European farmland biodiversity have ever-smaller chances of recovery.

Competing interests

The authors have no competing interests to declare.

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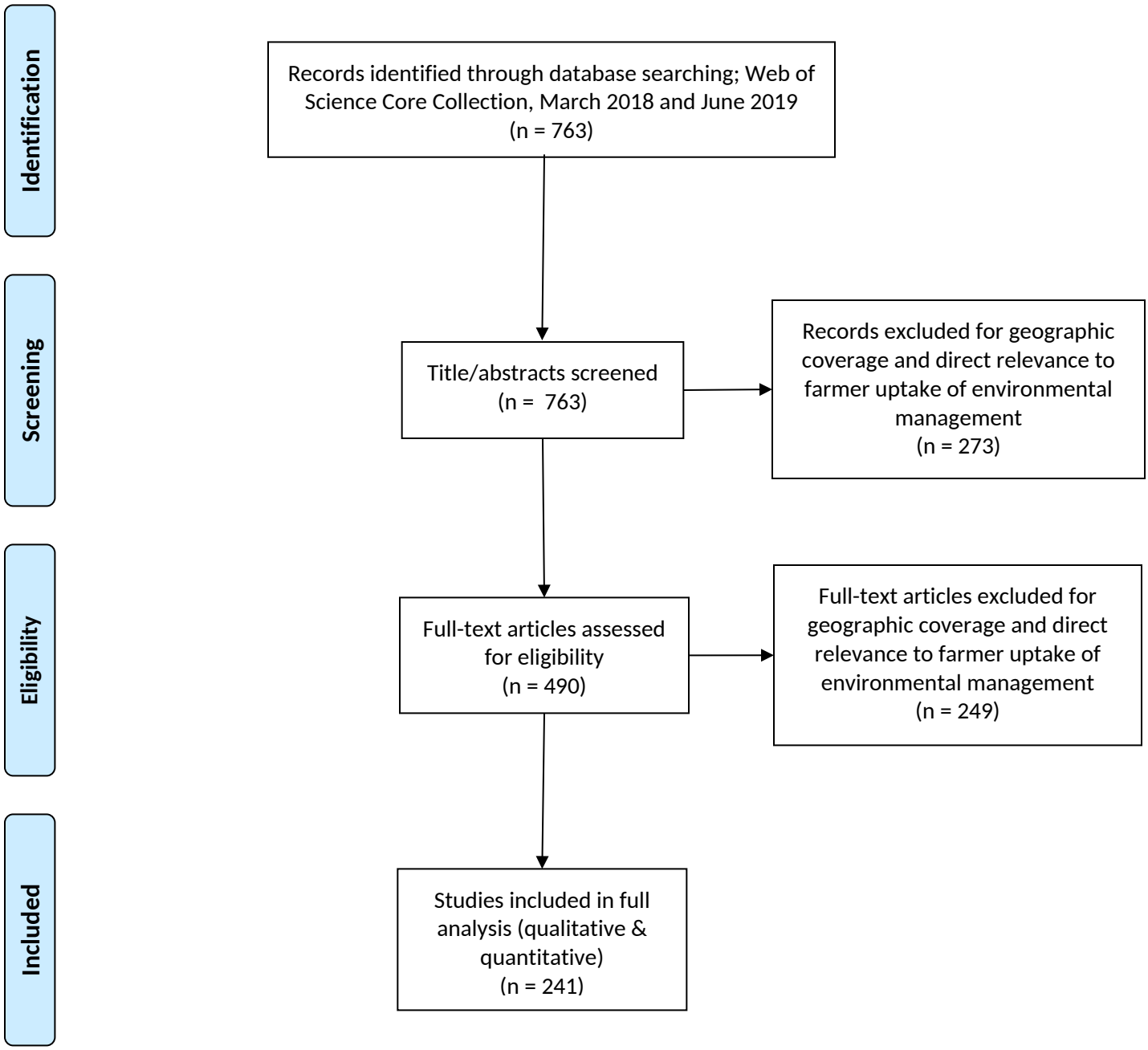
Identification
Screening
Eligibility
Included
Records identified through database searching; Web of Science Core Collection, March 2018 and June 2019 (n = 763)
Title/abstracts screened (n = 763)
Records excluded for geographic coverage and direct relevance to farmer uptake of environmental management (n = 273)
Full-text articles assessed for eligibility (n = 490)
Full-text articles excluded for geographic coverage and direct relevance to farmer uptake of environmental management (n = 249)
Studies included in full analysis (qualitative & quantitative) (n = 241)

The authors declare no conflicts of interest

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Appendix 1: Categories used in Rapid Evidence Assessment literature review

The literature review conducted for this study involved the extraction of a range of information from the papers included. Table A1 gives the categories used for this extraction, as well as a brief explanation of each.

Table A1: Categories used in the Rapid Evidence Assessment and their explanations. An entry for each category (row) was recorded for each paper in the review, unless the information required was not contained in the paper (e.g. theoretical framework not given, or factors not included).

Category	**Explanation**
Paper details	
Authors	Authors of paper
Year of publication	Year paper published
Keywords	Keywords as given in the publication
Country(ies) covered	List of countries included in the paper
Measure/scheme	The management options under study (e.g. Ecological Focus Areas, Agri-Environmental Schemes)
Research questions	The study's research questions, where given
Farmer contact	Whether the study involved direct contact with farmers or not
Method1	The (primary) method used, as described in the paper
Method2	Any secondary method(s), as described in the paper
Method of survey	If study involved a survey, the method by which it was conducted
Theoretical framework	Theoretical framework or basis for the study, if given, as described in the paper
Reference (DOI)	The DOI of the paper or full reference if unavailable
Findings	
Financial	Financial factors reported as affecting farmer uptake of the management options under study
Direction of financial effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Structural	Structural factors reported as affecting farmer uptake of the management options under study (e.g. location, farm type, size, property rights/ownership)
Direction of structural effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Socio-demographic	Socio-demographic factors reported as affecting farmer uptake of the management options under study
Direction of Socio-demographic effects (-2, +2	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Values	Values-related factors reported as affecting farmer uptake of the management options under study (e.g. values, norms, beliefs related to stewardship, social role, image of farming)
Direction of values effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Policy	Policy factors reported as affecting farmer uptake of the management options under study (e.g. design and implementation: complexity, flexibility, fairness, communication, enforcement)
Direction of policy effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Ecological	Ecological factors reported as affecting farmer uptake of the management options under study (e.g. environmental awareness, specific ecological considerations)
Direction of ecological effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Political	Political factors reported as affecting farmer uptake of the management options under study (e.g. perceived legitimacy of body responsible for scheme (government etc.))
Direction of political effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
Others	Any other factors reported as affecting farmer uptake of the management options under study
Direction of other effects (-2, +2)	The reported direction of the factor effects (whether increasing (+ve) or decreasing (-ve) uptake, and reported strength, if available (weak = 1, strong = 2).
General	
Other comments	Any comments on the paper by the reviewer
Paper recommendations	Specific recommendations made in the paper relating to farmer uptake
Quality Check	Any comments or concerns about the paper's quality by the reviewer
Reviewer	Reviewer identity

Appendix 2: Interview guidelines

This study involved semi-structured interviews with national-level decision-makers and with farmer representatives or advisors, as described in the main text. This Appendix contains the interview guidelines used for both sets of interviews. Not all of the questions are relevant to this particular study, but are included here for the sake of completeness.

Policy interviews

Introduction to interview purpose, format and use, followed by questions on political decision-making:

Could you please describe the process of selecting selected the EFA measures for national implementation in *name of country*?

Optional: Did you observe any controversies among different actors in the negotiation process?

Optional: How did you make use of existing evaluations/reports

Optional: Who was on the committee? Were there farmers/scientists involved?

Based on a literature survey, our team identified the following EFA options as most effective (*also showing list)*:

1. Fallows (with caveats re: species composition and management)
2. Agroforestry (e.g. production systems in their context that are compatible with agroforestry principles)
3. Landscape elements, especially in association with other measures
4. Buffer strips, especially with diverse vegetation type and structure
5. **Wildflower strips*
6. **Use of organic rather than mineral fertilizers*
7. **Maintaining ground cover in orchards in Mediterranean regions*
   **Planting hedgerows in Mediterranean regions*

Can you please tell us the key reasons for selecting EFA measures X [*adjust as appropriate*] for national implementation?

Can you please tell us the key reasons for rejecting EFA measures Y [*adjust as appropriate*] for national implementation?

Has the originally selected portfolio of EFA options been adapted over time? If yes, for which reasons?

Looking at the upcoming CAP reform, how do you expect the EFA options on the EU and national levels to change?

How can the political process for selecting EFAs on the national level be improved?

What is your country's official position on the EU EFA policy?

In light of all these questions, which other person would be important to talk to regarding the EFA selection on the national level in 'name of country"?

Questions on farmer decision-making, using the same list of EFA options:

How do you think farmers perceive these different EFA options?

What do you think are their main motives for selecting certain EFA options?

What do you think are their main motives for not selecting certain EFA options?

Farmer representative interviews

Introduction to interview purpose, format and use, followed by questions on farmer decision-making:

Current policy:

What are the factors that, in your experience, influence farmers' adoption of environmental measures?

Introduce prompts & EFA options:

In this table, factors are listed that have been shown in research literature to influence farmers' decision-making with respect to environmental measures. Some act as barriers and some as incentives. You can evaluate their strength of effect from -2 to +2 (-2=Very strong barrier, -1=Strong barrier, 0=Nor a barrier or an incentive, 1=Strong Incentive, 2=Very strong incentive) based on your experience. You can give a general assessment (for all EFA measures) or specify if for some factors the assessments differ by EFA measure.

Factors	**-2**	**-1**	**0**	**1**	**2**
Farm profitability					
Payment for adopting biodiversity measures					
Implementation costs					
Income lost due to implementation					
Risks to productivity					
Small farm size					
Farm type: husbandry					
Extensive land use					
Good soil properties of farm					
Property rights: uncertain or shared ownership					
Farm practices compatible with practices for implementation of measure					
Being a 'young' farmer					
Full time farmers					
Farmers with agriculture-oriented training/education					
Previous experience in applying similar measures					
Farmers' perceived responsibility to future generations					
Farmers' perceived role in society					
Farmers' perceived responsibility to the environment					
Farmers' understanding of other farmers as their peers					
Farmers' knowledge about environment/biodiversity					
Farmers see measures as environmentally beneficial					
Farmers trust governmental agencies					
Complexity of measures					
Flexibility of contract					
Existence of administrative assistance for implementation					
Voluntary nature of measures					
Other factors (please specify)					

Would you say that your evaluation is true of most farmers you work with or know about? If not, how does their opinion differ from your evaluation? (e.g., are there different groups of farmers in that regard?)

Please evaluate the following statements (general assessment):

	I totally disagree	**I relatively disagree**	**Neither agree or disagree**	**I relatively agree**	**I totally agree**	**Additional remarks**
Higher payment rates for longer contractual agreements would encourage greater uptake						
Bonus payments if a greater proportion of farmers in an area engaged in the measures, would be attractive to farmers and increase uptake						
Bonus payment if farmers in an area engaged in the measures as part of a collective venture, would be attractive to farmers and increase uptake						
Bonus payments if a greater environmental benefit is achieved (results-based payments) would be attractive to farmers and increase uptake						
Farmers choose measures that are easier or cheaper to implement on their farms						
Less intensively managed farms have generally been found to be associated with a greater uptake of environmental measures						
Farmers who rent rather than own a large proportion of their land are less willing or able to enter into environmental measures agreements						
Available labour limits the participation of farmers across the range of measures						
Farmers' technological or mechanisation capacity influence participation in biodiversity measures						
It is less likely that older farmers take measures up						
It is less likely that female farmers take measures up						
Farmers that care only about production are less likely to take measures up						
Farmers with a greater sense of environmental or cross-generational responsibility are more likely to take schemes up						
Risk averse farmers are less likely to take schemes up						
Monitoring of outcomes has some negative impacts on uptake						
Well-defined, meaningful indicators and low admin burdens facilitate uptake						
Voluntary participation may prompt widespread uptake						
Transparency and trust are sufficient to make stricter obligations acceptable						
Proven environmental benefits of a measure influence uptake in a positive way						
Perception that land is in need of environmental protection, or that land is degraded motivates uptake						
Trust in government is crucial for uptake of measures						

In your opinion, how can policy makers improve the uptake of the most effective measures for biodiversity?

1. Fallows (especially when having diverse composition and management that takes nature into account)
2. Landscape elements, especially in association with other measures (for example, buffer strips around woodland)
3. Buffer strips, especially with diverse vegetation type and structure

Here are some statements for which we would like you to share your level agreement or disagreement and/or provide further comments.

	I totally disagree	**I relatively disagree**	**Neither agree or disagree**	**I relatively agree**	**I totally agree**	**Additional remarks**
The implementation of environmental measures can increase farms' land value						
Limiting choice to only those measures with clear biodiversity benefits may discourage farmers to engage						
Measures need to be less risky						
Smaller farms should be provided with more opportunities to engage in measures						
Part-time farmers should be assisted to engage in measures						
Farms oriented towards maximizing production should be encouraged to engage in measures						
Farmers who rent (most of) land rather than own it should be assisted to engage in measures						
Some farmers prioritise the improvement of wildlife habitats and a range of social parameters, such as time saved for family and social recognition, over standard economic drivers. Policy should identify and target such farmer types to increase uptake						
Biodiversity benefits of measures should be strongly communicated						
Effective & mutlifunctional options (fallow, buffers and some landscape features) should be made obligatory, not optional, with a minimum overall area target for each country						