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Drivers and Preferences of European Farmers for Agri-Environmental Public Goods Schemes: A Two-Stage Analysis

Emmanouil Tyllianakis [a,e,*], Meike Will [b], Tomáš Václavík [c], Guy Ziv [d]

[a] Sustainability Research Institute, University of Leeds, Leeds, United Kingdom
[b] Helmholtz Centre for Environmental Research - UFZ, Department of Ecological Modelling, Permoserstraße 15, 04318 Leipzig, Germany
[c] Faculty of Science, Department of Ecology and Environmental Sciences, Palacký University Olomouc, Olomouc, Czech Republic
[d] School of Geography, University of Leeds, Leeds, United Kingdom
[e] Institute of Energy and Sustainable Development, De Montfort University, Leicester LE1 9BH, United Kingdom

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ABSTRACT

The new Common Agriculture Policy (CAP) intends to give more freedom to countries to manage their budget while increasing funding for income support and provisioning of climate public goods from agriculture and farming. For the past 20 years this has been operationalised through incentivising farmers' contract participation in agri-environmental schemes (AES). In this paper we examine through a two-stage approach, farmer preferences for contract characteristics in a multi-European country Discrete Choice Experiment (DCE) and the determinants of land enrolment in contracts. Overall, we find that longer contracts and high administrative burden decrease the probability of enrolling in a contract over the base levels while shorter contract length and provisioning of advisory support are desirable. Amongst all available contract options, converting arable to grassland options was by far the one that participants asked the most compensation for, across countries. We also find that past experience with agri-environmental schemes and socio-demographics have a strong and statistically significant effect on the percentage of land enrolled, while contract characteristics do not influence enrolment. Finally, we present some evidence of position-ordering effects affecting preferences for contracts and their characteristics but not influencing contract enrolment. Understanding the true cost incurred by farmers to implement AES is crucial for policymakers as failure to do so can make farmers ask for much higher compensation, per hectare, potentially to cover costs of transitioning to different types of farming or to incorporate financial risk by significantly altering their farm practices.

1. Introduction

The European Union (EU) has a long history of attempting to balance agricultural food provisioning and provide public goods from the wide expanses of agricultural land it occupies (EEA, 2020). The 2019-published European Green Deal from the European Commission laid out ambitious goals regarding the operationalisation of the Common Agricultural Policy (CAP) as a means to carry out climate actions (European Commission, 2019) such as making European Union (EU) agriculture carbon–neutral by 2050, increasing funding to voluntary environmental support schemes and linking farmer payments to stricter environmental, climate and biodiversity targets (European Commission, 2022). This operationalisation is seen from the increased budget allocated to rural development (which includes annual eco-schemes that pay farmers to carry out climate-and environment-friendly farming practices), as well as allowing countries to move more funds from income support to further support rural development (up to 25 % of a country's CAP allocations, European Commission, 2022). The new CAP's "*strong emphasis on results and performance*" through stronger mandatory requirements for environmental and climate goods (European Commission, 2022) is expected to have adverse effects with one of the traditional goals of CAP: providing income support to farmers (Hasler et al., 2022). In the upcoming CAP the trade-offs between food production, income support and provisioning of climate public goods from agriculture and farming have somehow amalgamated in additional environmental requirements for land managers.

The diversified development funding in the new CAP invests more in agri-environmental schemes (AES), which aim to incentivise delivery of

* Corresponding author.
E-mail address: Emmanouil.tyllianakis@dmu.ac.uk (E. Tyllianakis).

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public goods through subsidising foregone income or costs incurred during their implementation. In particular, AES aim to either modify or improve existing farming practices that are not beneficial to the environment or preserve existing services that are proven to provide public good benefits (Röder and Matthews, 2021). Outside of AES, other measures are employed to provide such public goods, as introduced by the "greening" element of the 2013 CAP reform, requiring farmers to diversify crops, maintain permanent grasslands and set aside 5 % of their land as Ecological Focus Areas (Hasler et al., 2022). Currently, a wide array of AES exists, including simple to carry out schemes such as buffer zones and reducing fertilizer rate (Jones et al., 2017) and more demanding and complex ones such as cover crops and conversion to grassland (Zimmermann and Britz, 2016). Increasing farmer participation is therefore a core element in mainstreaming uptake of AES, as participation varies considerably across the EU (Eurostat, 2017). Hasler et al., (2022) summarise the determinants of uptake in AES in farmer characteristics (such as farmers' motivations, risk perceptions, cognitive biases and farmers' norms) and farm-related characteristics (such as type of land practices and size of land managed).

The most common means to assess *stated* enrolment in hypothetical AES that have varying scheme characteristics and their impact on enrolment in the literature is through survey-based approaches (e.g., Ruto and Garrod, 2009; Espinosa-Goded et al., 2010; Schulz et al., 2014; Czajkowski et al., 2019; Villamayor-Tomas et al, 2019; Schaak and Musshoff, 2020; Niskanen et al., 2021). Survey-based studies have examined the effect of farmer and farm-related characteristics as determinants of adoption of AES using quantitative (e.g., Kuhfuss et al., 2016; Grammatikopoulou et al., 2016; Latacz-Lohmann and Breustedt, 2019; Tanaka et al., 2022) or qualitative methods (eg., Bartkowski et al., 2023). A method which has seen wide use in helping design and evaluate AES and their characteristics is the Discrete Choice Experiment (DCE) method (Latacz-Lohmann and Breustedt, 2019). It relies on stated preferences of survey respondents who are asked to choose from hypothetical options, while the estimation allows for monetary values to be assigned on different choices (Niskanen et al, 2021). Few DCE studies though have examined farmers' stated behaviour (such as how much land they would enrol) jointly with contract characteristics, farmer and farm-related aspects *after* adopting hypothetical AES (Kuhfuss et al., 2016; Vaissière et al., 2018; Latacz-Lohmann and Breustedt, 2019; Tanaka et al., 2022). This study contributes to this literature through a two-staged approach; first examining farmer preferences for contract characteristics through a multi-European country DCE and second through a regression analysis to examine which factors affect land enrolment in AES.

We focus on hypothetical schemes similar to those that are currently offered in most of our case studies countries of Germany Czech Republic and United Kingdom (UK), such as flower strips, cover crops and maintaining grasslands. We also introduce a new AES which is yet offered only in one case study country (UK, converting arable to grassland). See Section 3 for a description of the case study countries' AES. Finally, this paper addresses position-ordering effects in a stated preference study from the supply-side of public goods (i.e., AES). Position-ordering effects might influence acceptance of schemes if a participant always makes choices based on the order of an alternative (for example, the first one), especially with respect to the opting-out alternative (Nguyen et al., 2015). The next section of the paper briefly reviews the existing literature on explaining land enrolled in schemes based on contract characteristics. Section 3 describes the questionnaire presented to farmers in Germany, Czech Republic and United Kingdom. The description of the choice experiment, the model specification and data collection process are presented in the subsequent sections, followed by the results, discussion and concluding remarks.

2. Literature review

The application of the two-stage approach is not uncommon in farmer behaviour studies. This section discusses the relevant literature, making a distinction between the stated and revealed preferences farmer modes, as some studies examine actual behaviour of farmers (e.g., Chang and Boisvert, 2009; Giovanopoulou et al., 2011) instead of stated behaviour. This section focuses only on studies that collect stated preference/behaviour data on enrolment in agri-environmental schemes in studies employing DCEs and two-stage estimation methods and not on farmer surveys employing the same methods to examine post-choice behaviour such as Zemo and Termansen (2018) and Wang et al. (2019).

Kuhfuss et al. (2016) are the first who investigated farmer preferences for being compensated for reducing herbicide use via a collective bonus on top of an individual payment. Participants were asked to state how much of their land they would enrol in their chosen contract. Their results indicate that the individual payment and collective bonus increased both likelihood of enrolment and of land enrolled. No other contract characteristics were found to influence the percentage of stated land enrolled.

Vaissière et al. (2018) examined responses of Picardy farmers in France to enrol in biodiversity offsetting contracts through stating preferred options in a DCE that offered a bonus payment on top of the baseline offered compensation. Those who chose the option containing the bonus were asked how much of their lands they would connect (a requirement in such schemes to ensure habitat connectivity) if such a scheme was applied. Responses showed that participants were keen to enrol a mean of 13 % of their Utilised Agricultural Area in such contracts. The level of the bonus increased both the likelihood of enrolment and of Utilised Agricultural Area enrolled, similar to Kuhfuss et al. (2016).

Latacz-Lohmann and Breustedt (2019) examined German farmers' willingness to participate in conservation contracts in exchange for compensation, followed by questions on how much land they would choose to enrol. Results indicated that no contract characteristics influenced the stated percentage of land enrolled in any of the three offered schemes (while they did influence initial enrolment in the scheme, similar to Kuhfuss et al., (2016), Vaissière et al., (2018) and Tanaka et al., (2022)). This is partly explained by the adverse effects that opting in a contract had on the correction terms in the second stage of the estimation. Nevertheless, non-contract related aspects such as farm structure, future plans for the farm and having lands under protection status (i.e., Natura 2000) had a statistically significant influence in the percentage of land enrolled.

Finally, Tanaka et al. (2022) estimated preferences for Japanese rice growers to enrol in a results-based payment for ecosystem services scheme and subsequent stated land enrolled. They found that, similar to the studies above, compensation levels had a positive influence both on adoption and the land enrolled in such a scheme while most other contract features do not influence the stated land enrolled.

Overall, the above studies examine preferences using two-stage approaches but in unlabelled formats. Such formats are preferred when researchers are interested only in the influence of individual contract characteristics while labelled formats are preferred when existing contracts that are understandable to participants are to be examined (ChoiceMetrics,2018). This study contributes to the literature by eliciting preferences for labelled alternatives and subsequent stated enrolment in each of them.

3. Methods and data

Our questionnaire was part of a wider, multi-country European project (Ziv et al., 2020) and the English case study version is available in the Supplementary Material. It consisted of five sections, with the first focusing on the structure of the farm. The second section of the questionnaire contained the DCE (see detailed description in the next section). The third section focused on prior experience with AES which has been documented to increase farmer participation (Herzon and Mikk, 2007; Defransesco et al., 2008; Espinosa-Goded et al., 2010). We specifically asked about experience with existing AES in the case study that best matched the hypothetical AES we offer in the DCE. In all case studies three of the four schemes are currently offered. Section four dealt with personal views of farmers on the objectives of farming, the environment, interaction with other farmers, and whether they apply new technologies in their farm. The final section of the questionnaire included questions on key sociodemographic characteristics such as gender, age, education, and other income sources besides farming.

3.1. Survey and choice experiment description

The main objective of the DCE is to investigate the preferences of farmers across three case studies from the ones described in Ziv et al., (2020) for a selection of agri-environment contracts (namely, flower strips/areas, cover crops, maintaining permanent grassland and conversion of arable land to permanent grassland) and their characteristics. These contracts are chosen (i) because they exist, with roughly similar implementations (apart from conversion of arable land to permanent grassland), in all case studies; (ii) due to their relative existing use in terms of spatial coverage of AES across case studies; and (iii) because they are seen as relevant for future AES implementations of the CAP (referring only to conversion of arable land to permanent grassland). Definitions of the hypothetical schemes are presented based on existing contract characteristics across case studies.

The characteristics of these contracts included as attributes in the DCE are commonly used in similar studies examining preferences for AES. These are contract duration (1, 5 and 10 years were offered) (Christensen et al., 2011; Vaissière et al., 2018), the possibility of having advisory support for the duration of the contract (yes or no) (Emery and Franks, 2012; Tyllianakis and Martin-Ortega, 2021) and the levels of administrative effort for the farmer (low, medium and high) (Ruto and Garrod, 2009; Mack et al., 2019). Compensation per hectare enrolled in the proposed contract, per year, is the final contract characteristic, with levels varying for each country. Five compensation levels for each country are available and we use the current payment level per hectare as the reference level, the rest of the compensation levels consisted of an approximate 25 % decrease, 15 % decrease, 15 % increase and 25 % increase over the reference level. See Appendix A for a full description of all payments, per country. The reference levels for each flower strips, cover crops and maintaining grassland were based on the official figures for such payments in CZ, DE and the UK while conversion from arable to farming levels were informed by the pretest phase. An opt-out option was also made available as a fifth option to the participants where they would receive no compensation for any agri-environmental practices carried out in their land.

To examine potential ordering effects relating to the position of the opt-out option (conceptualised as “position order effects” in the literature) (Carlsson et al., 2012; Day et al., 2012; Nguyen et al., 2015) the opt-out is presented in a random order to half of the participants (the other half were always presented choices with the opt-out in the end, as in Fig. 1), following the usual approach of split sample comparison (e.g., Scheufele and Bennett, 2012). This allows us to examine the two following effects: a) whether the order of the opt-out affects the probability of a contract being selected and b) whether the order of the opt-out influences the selection of the non-opt-out alternatives.

Each DCE’s framing is tailored to a case study’s framing of AES that participants can already be familiar with (e.g., in the UK the contracts are presented as Countryside Stewardship-offered contracts) while stressing the hypothetical nature of the options. A ‘cheap talk’ script is also used to incentivize participants to answer truthfully (Carlsson et al., 2005). Before each choice participants are reminded the following: “*If you do not have permanent grassland, please do not consider the option “Maintaining permanent grassland”*” to ensure that options selected are realistic. For these participants this option is confounded with the opt-out options in the analysis. After each choice other than the “no scheme” option respondents are asked to indicate the percentage of land they would be willing to enrol the contract they have just selected, both in terms of arable and of grassland extent. If a respondent choses the “no scheme” option every time they are prompted to choose the reason why from the following options: “*I am generally not willing to enrol in agri-environmental schemes*”, “*I did not find the options suitable for my land or current situation*”, “*Enrolling in such schemes would be a bad financial decision for me*” and “*There is no need for actions to protect the environment in my farm*”. A question if a participant never choses the conversion to arable option is also inserted using the aforementioned options for the opt-out to determine why this hypothetical scheme is not feasible.

All contracts and their characteristics are dummy coded with the base level being equal to zero, apart from the compensation one. The full list and coding of the contracts’ attributes can be seen in Table 1 below while the full list of the payment levels for each country can be seen in

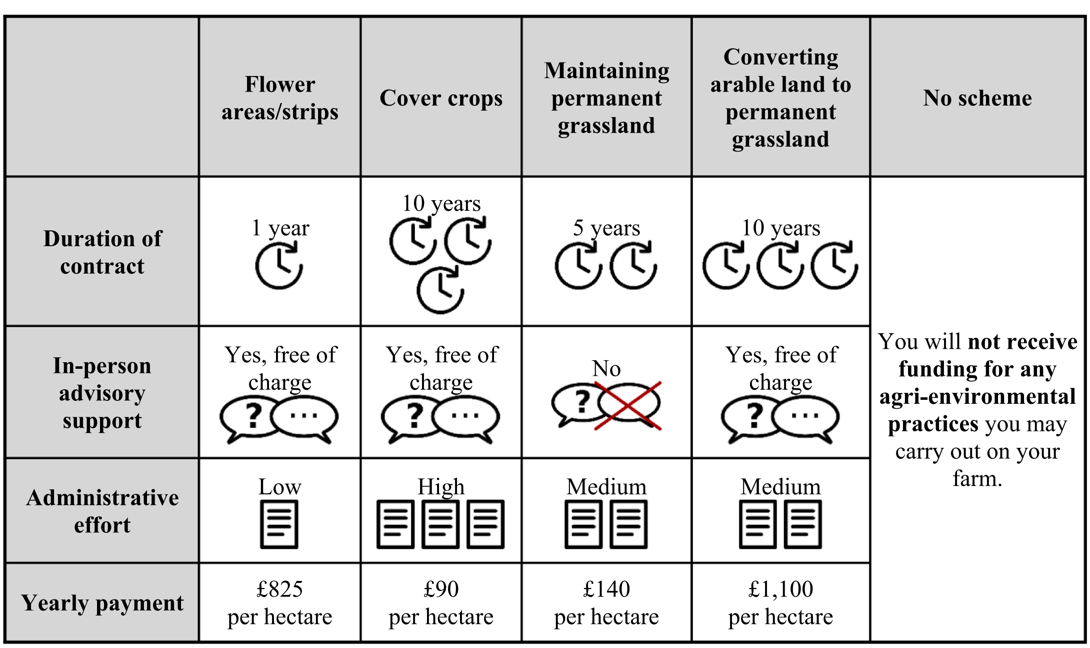

Fig. 1. Example of a choice card from the UK survey scheme.

Table 1
Description of contract characteristics and other variables used to explain farmers' choices. Note: Levels in bold indicate the reference level.

Contract characteristics	*Levels*	*Coding*
Contract length (CONTRACT)	1,**5**, 10 years duration	Binary
Advisory support (SUPPORT)	**No support**, Free support is provided	Binary
Administrative effort (ADMIN)	Low, **Medium**, High	Binary
Yearly Payment (COMPENSATION), per hectare	5 payment levels for each of the four contract types (see Appendix B1 for the full list, for each country)	Continuous
Non-contract characteristics	*Description*	*Coding*
Flower strips experience (FLOWER_EXP)	1 if a participant is or has in the past enrolled in flower strips AES, 0 otherwise	Binary
Grassland maintenance experience (GRASS_EXP)	1 if a participant is or has in the past enrolled in grassland-maintaining AES, 0 otherwise	Binary
Other AES experience (OTHER_EXP)	1 if a participant has experience with other types of AES, 0 otherwise	Binary
Successor (SUCCESSOR)	1 if a participant has named a successor for their farm, 0 otherwise	Binary
Source of income (OTHER_SOURCE_INCOME)	1 if a participant has other sources of income besides agriculture, 0 otherwise	Binary
Educated participant (EDUCATION)	1 if a participant has higher than Bachelor's degree education, 0 otherwise	Binary
Access to markets (MARKET)	1 if more than 50 % of a participant's products are targeting consumers, 0 otherwise	Binary
Farm income source (FARM_INC_SOURCE)	1 if more than 50 % of a participant's income comes from farming, 0 otherwise	Binary
Gender (MALE)	1 if a participant identifies as male, 0 if participant identifies as female	Binary
Land to be enrolled in AES (LAND_PCT)	The average percentage of arable and/or grassland a participant stated they would enrol in a hypothetical AES	Continuous

Table B1 in the Appendix. The 5-year duration, no advisory support and a medium administrative burden levels are used as the reference level. An example of a choice card (from the UK survey) can be seen in Fig. 1 below.

Several non-contract-related characteristics relating to past experience and socio-demographic characteristics were used to explain choices of farmers, sampled in other sections of the questionnaire. Following the scope of the paper and the wider literature, they reflect elements of past experience with AES and sociodemographic characteristics. In detail, these include past or current experience with AES (Herzon and Mikk, 2007; Defransesco et al., 2008) targeting flower strips creation and maintaining grasslands (FLOWER_EXP and GRASS_EXP, respectively, taking the value 1 if such experience existed, 0 otherwise). These two types of AES were the only ones that were currently available to farmers in all three case studies that offer AES. Experience with other types of AES such as maintaining cover crops or any other type of AES offered by government or private providers was also captured (OTHER_EXP, taking the value 1 if such experience existed, 0 otherwise). Socio-demographic characteristics expecting to influence farmer choices were also used, such as gender (MALE, taking the value 1 if a participant identified as male, 0 otherwise) (Ruto and Garrod, 2009; Schultz et al., 2014), if they had more than a Bachelor's level education (EDUCATION = 1, 0 otherwise) (Ruto and Garrod, 2009; Defrancesco et al., 2008), if they had a named successor for their farm (SUCCESSOR, taking the value 1 if the answer was "yes", 0 otherwise) (Defransesco et al., 2008), if they sold their majority of produce in markets through (for example) vegetable boxes (MARKET = 1, 0 otherwise) (Latacz-Lohmann and Breustedt, 2019), and if the majority of their income came from farming sources (FARM_INC_SOURCE = 1, 0 otherwise). The average percentage of land the participant stated they would enrol in their selected contract (apart from the "No contract" option which did not include such a question) (LAND_PCT) was also operationalised to examine farmers' preferences for the four hypothetical AES.

3.2. Model specification

Our DCE method is based on random utility theory (RUT, McFadden, 1974) which in this context assumes that land manager's i stated behaviour is approximated as:

$$U_{ij} = V_{ij} + \varepsilon_{ij} = \beta'_n X_{ij} + \varepsilon_{ij} \tag{1}$$

with U_{ij} denoting the unobserved utility of farmer i *(1….n)* when enrolling in a contract with alternative j while the stochastic (unknown) component ε_{ij} is considered as random and following an *i.i.d.* Gumbel type I extreme value distribution. As U_{ij} is unobserved, V_{ij} denotes the observed (indirect) utility which depends on a vector of social, economic, experiential and demographic characteristics X_{ij} of farmer i. The farmer-specific preference parameters β_n, over n farmers, are considered to be randomly distributed (Train, 2009).

The probability that farmer i chooses alternative j (1,…,5) in choice situation t (1,…,6) is given by:

$$P_{ij} = \int \prod_{t=1}^{T} \prod_{j=1}^{J} \left[\frac{\exp(X'_{itj}\beta)}{\sum_{j=1}^{J} \exp(X'_{itj}\beta)}^{y_{itj}} \right] f(\beta) d(\beta) \tag{2}$$

where$y_{itj} = 1$ if a farmer chose alternative j in choice situation t (0 otherwise). Equation (2) is commonly estimated with the Maximum Simulated Likelihood method. We used the *mixlogit* command is Stata (Hole, 2007) to estimate a Mixed Logit Model (MXL, also called "random parameter logit") that assumes the heterogeneity in preferences is randomly distributed. (Hensher and Greence, 2003).[1] The MXL model is preferred over the conditional logit or the multinomial models which require irrelevant alternatives to be independent, as it allows to relax this assumption. The mean value of the ratio of the distribution between any contract alternative and the compensation coefficient was estimated through parametric or non-parametric methods to produce the marginal rate of substitution (MRS) or willingness to accept. This corresponds to the economic value per hectare, per year of desired compensation for each contract characteristic and follows Czajkowski et al., (2021)'s notation of $\beta = \boldsymbol{b}/\alpha$.

If preference heterogeneity is considerable between choices and a researcher wants to depart from the continuously distributed random parameter specification (Mariel et al., 2021), an alternative approach is to assume homogeneous preferences between discrete classes of respondents. This approach can be estimated through a latent class model (LCM) and can use farmer and past experience characteristics as class determinants (Schaak and Musshoff, 2020; Tyllianakis et al., 2023). This model is also preferred by researchers due to its behavioural explanatory power and is commonly used in studies focusing on preferences of suppliers of goods (Mariel et al., 2021). The probability P of a farmer belonging to class c is depicted as:

$$P_c = \frac{e^{\gamma'_c Z_I}}{\sum_{c=1}^{C} e^{\gamma'_c Z_I}} \tag{3}$$

with Z denoting covariates and γ indicating class-specific

[1] A Hausman test showed that the independence of irrelevant alternatives (IIA) assumption for a multinomial logit model is violated at the 5 and 10% levels for an ASC-only model and models with reduced number of alternatives. Therefore, the MXL model that relaxes this assumption was preferred.

Table 2
Summary statistics of key non-contract characteristics, * mean value, ** Defined as the total owned and rented arable land, improved grassland, permanent grassland, permanent crops, vineyards, orchards, woodland or forestry, fallow, not in use and other land use.

Non-contract characteristics	*Frequencies*	*S.D.*	*Frequencies*	*S.D.*	*Frequencies*	*S.D.*
	Germany		*Czech Republic*		*United Kingdom*	
Flower strips experience (FLOWER_EXP)	0.54	0.50	0.16	0.37	0.64	0.48
Grassland maintenance experience (GRASS_EXP)	0.54	0.50	0.59	0.49	0.49	0.50
Other AES experience (OTHER_EXP)	0.57	0.49	0.15	0.35	0.21	0.40
Successor (SUCCESSOR)	0.07	0.25	0.09	0.28	0.42	0.49
Source of income (OTHER_SOURCE_INCOME)	0.28	0.49	0.20	0.41	0.45	0.50
Educated participant (EDUCATION)	0.37	0.48	0.45	0.50	0.27	0.44
Access to markets (MARKET)	0.14	0.35	0.19	0.39	0.21	0.40
Farm income source (FARM_INC_SOURCE)	0.80	0.39	0.83	0.38	0.66	0.47
Gender (MALE)	0.78	0.42	0.85	0.35	0.69	0.46
Total land managed* (in ha) **	1010.8	1392.4	715.5	952.2	605.1	2769.6
Observations	74		69		107	

coefficients.

To examine the potential impact of position ordering effects, we create interaction terms between all contract types and characteristics and the opt-out. In total, 10 interaction terms are considered, representing the four contact types and six contract characteristics (Nguyen et al., 2015).

As the contract characteristics and individual-specific characteristics are expected to determine the percentage of land enrolled in a scheme, selection bias is expected to be an issue (Heckman, 1979). Following Kuhfuss et al. (2016), and Tanaka et al. (2022), we apply a two-stage process using the predicted probabilities of the mixed logit model in Eq.2 to control for such biasness to explain the percentage of land l_{ijt} chosen to enrolled in a scheme, in a given alternative j, in choice situation t (if the respondent chose to enrol in the first place). As two-step approaches such as the Heckman (1979) approach require a non-linear model specification (such as that of the mixed logit model (Wooldridge, 2002)), a beta-regression is used as it allows for the dependent variable to take values between (but not equal to) 0 and 1 (corresponding to values between 0 and 100 % of land indicated to be enrolled in hypothetical AES presented to the participant).

Given the multinomial nature of the data and to avoid selection bias, we use a correction term μ_i, computed as a ratio of the predicted probabilities of individual l choosing a non-status-quo alternative $Prob_i$, (i=1, …,4) as:

$$l_{ijt} = \mathrm{B}_{ijt}\delta + \mu_i m_i + e_{ijt} \tag{4}$$

where$\mu_i = Prob_i\frac{\ln(Prob_i)}{1-Prob_i}$, $\delta$is a parameter vector from the choice of any of the four contracts described in characteristics, B_{ijt} estimated through the mixed logit model and e_{ijt} is an *i.i.d.* distributed error term. The m_i term is estimated as $\sigma\frac{\sqrt{6}}{\pi}r$ where σ is the standard deviation of e_{ijt} and r is the correlation between e_{ijt} and ε_{ij}.

We differ in our approach from Kuhfuss et al. (2016) and Tanaka et al. (2022) due to the labelled approach chosen in the DCE, separate regressions are run requiring only one correction term per equation (one equation per different contract offered to participants) and μ_i not being calculated for the opt-out as it does not reflect a contract where land is enrolled in.

To minimize the sample size required to estimate true preferences from farmers in the three CS, we create an S-efficient statistical design (Alcon et al., 2014) for a labelled choice experiment with two blocks and six choice cards each was via Ngene (ChoiceMetrics, 2012, Version 1.1.1.) with fixed priors. Priors for contract duration and administrative effort are derived from the pooled estimates of Ruto and Garrod (2009) and advisory support priors are obtained from Tyllianakis and Martin-Ortega (2021). This design was pretested with 13 completed questionnaires from the three case studies collected through farmer and expert focus groups that between September and October 2021 and estimated coefficients were used as priors to improve the statistical design from an S-error of 70.62 to the final of 60.02 (D-error 0.0047 and 0.0045 accordingly). All countries share the same statistical design.

3.3. Sample description

Data collection in the three case studies took place between September 2021 and April 2022. Overall, 440 questionnaires were collected (146 in DE, 140 in CZ and 154 in the UK). Data from farmers were collected through online questionnaires and were disseminated through established farmer networks from the co-authors in DE and CZ while in the UK case all but nine questionnaires were obtained through a country-wide farmer panel purchased from the survey company Qualtrics. After removing serial non-participants,[2] incomplete questionnaires and speeders (those taking less than 5 min to go through the survey, i.e., 30 % less than the median survey completion time, following Tyllianakis et al., 2023) 250 questionnaires (74 in DE, 69 in CZ and 107 in the UK) were retained for analysis. The majority of the incomplete questionnaires dropped out during the DCE part of the survey. The median completion time in the retained questionnaires was 21 min for DE and CZ and 9 min for the UK (experienced with farmer surveys) sample.

4. Results

The descriptive statistics for the full sample of the three countries on key non-contract characteristics (as described in Table 1) are presented in Table 2 below. Flower strips are mostly common amongst UK and DE farmers while UK farmers have much higher rates of naming a farm successor than the other two case studies. Most farmers in all three cases receive their income from non-market sources, as evidenced by the low percentages in the MARKET covariate while still being little involved in activities such as tourism, as evidenced by the relatively high percentages of the FARM_INC_SOURCE covariate.

4.1. Choice experiment results

The results from the MXL model with no interaction terms with other non-contract variables are presented in Table 3, along with the marginal rate of substitution which indicates farmers' desired compensation for enrolling in AES. All parameters are considered to follow a normal distribution apart from compensation which followed a log-normal one. For the MRS estimation, as the log-normally distributed coefficient of COMP has high standard deviations both in the pooled and country-specific models, we use the median value which is independent from the mean (Bliemer and Rose, 2013) following Knoefel et al., (2018). The

[2] Those who chose the "no scheme" option every time and the "I am generally not willing to enrol in agri-environmental schemes" response. This resulted in 30 responses to be removed.

Table 3
Coefficients and marginal rate of substitution for contracts and contract characteristics (standard error in parentheses). ¥: converted in Euros; ′□: median value***, **,* denote statistical significance at the 1%, 5% and 10% level respectively.

	Pooled sample		Germany		Czech Republic		United Kingdom	
Choice	*Coeff*	*MRS*	*Coeff*	*MRS*	*Coeff*	*MRS*	*Coeff*	*MRS*¥
FLOWER	0.039	24.56	−0.579	−280.59*	3.247***	936.29*	0.388*	412.41*
	(0.144)	(127.88)	(0.410)	(340.03)	(0.464)	(2551.94)	(0.232)	(916.77)
COVER	0.173	107.95	−0.242	−117.08	0.603**	173.84	1.060***	1127.10***
	(0.112)	(399.87)	(0.195)	(114.93)	(0.298)	(492.88)	(0.192)	(2421.38)
GRASS	0.259**	161.91**	−0.253	−122.72	2.478***	714.39**	0.592***	629.60**
	(0.113)	(594.77)	(0.228)	(163.69)	(0.328)	(1946.08)	(0.200)	(1364.41)
ARB_GRASS	−1.406***	−877.55***	−4.250***	−2059.38***	3.547***	1022.75*	−0.350	−371.92
	(0.250)	(3204.45)	(0.878)	(2070.37)	(0.590)	(2791.25)	(0.326)	(868.43)
CONTRACT1	0.091	56.97	0.520***	251.72***	−0.325	−93.77	0.024	25.29
	(0.101)	(217.09)	(0.182)	(262.93)	(0.250)	(280.89)	(0.132)	(150.14)
CONTRACT10	−0.197*	−123.12*	−0.814***	−394.59***	−0.427	−123.20	0.048	50.80
	(0.103)	(453.65)	(0.247)	(406.22)	(0.302)	(36408)	(0.120)	(167.45)
SUPPORT	0.197*	123.01*	0.202	98.03	−0.286	−82.46	0.394***	419.15***
	(0.111)	(453.94)	(0.198)	(136.12)	(0.348)	(278.43)	(0.133)	(908.40)
ADMIN_LOW	−0.036	–22.64	0.265	128.24	−0.675***	194.71**	0.052	55.31
	(0.100)	(103.68)	(0.226)	(166.97)	(0.290)	(546.33)	(0.133)	(184.80)
ADMIN_HIGH	−0.430***	−268.32***	−0.719***	−348.40**	−0.676*	194.81*	−0.080	−84.79
	(0.123)	(981.62)	(0.261)	(365.34)	(0.409)	(564.62)	(0.141)	(235.34)
COMPENSATION	0.001***	–	0.001***	–	0.003**	–	0.001***	–
	(0.006)		(0.001)		(0.011)		(0.001)	
St. Deviations								
CONTRACT1	0.596***	–	0.611**	–	1.021***	–	−0.385*	–
	(0.165)		(0.265)		0.330)		(0.215)	
CONTRACT10	0.692***	–	0.908***	–	0.811**	–	0.435**	–
	(0.143)		(0.297)		(0.328)		(0.200)	
SUPPORT	0.903***	–	0.602**	–	0.665 (0.434)	–	0.613***	–
	(0.137)		(0.247)				(0.219)	
ADMIN_LOW	0.342*	–	0.440 (0.353)	–	0.574 (0.387)	–	0.029 (0.307)	–
	(0.198)							
ADMIN_HIGH	0.658***	–	0.352 (0.351)	–	1.068**	–	0.573***	–
	(0.172)				(0.433)		(0.201)	
COMPENSATION′	0.004***	–	0.001***	–	0.002 (0.003)	–	0.002***	–
	(0.003)		(0.001)				(0.001)	
Observations	250		74		69		107	
Pseudo R^2	0.05		0.06		0.14		0.03	
BIC	4601.791		1303.311		1197.367		2022.038	
Log-likelihood	−2229.611		−605.90293		−627.4418		−978.50387	

MRS estimates onward therefore refer to the median and not the mean of the MRS distribution with the median and standard error estimated using the Krinsky and Robb (1986) method. By estimating the MRS ratio from Eq.(2), such estimates can take both negative and positive values. Following Ruto and Garrod (2009), negative values are interpreted as farmers requiring compensation (per hectare, per year) for accepting less desirable contract features while positive values are interpreted as the discount (per hectare, per year) that farmers are willing to provide if desirable contract characteristics are available in an offered contract. There is no attribute non-attendance across the models as different contract features are statistically significant in different models.

Table 3 presents estimates and MRS for Germany, Czech Republic and the UK combined (see *pooled* columns) since their compensation levels as well as previous AES were or currently are influenced by the CAP and share several similarities, as well as individual estimates for all three countries. Four alternative-specific constants (ASCs) are inserted in the model to capture preferences and the MRS for enrolling in each of the four different contract types (FLOWER, COVER, GRASS and ARB_GRASS for flower area/strips, cover crops, maintaining grassland and converting arable land to grassland, respectively).

From the results of Table 3 it is evident that compensation has the desired sign (positive, apart from the UK where results came from a cross-country sample instead of region-specific samples for DE and CZ) and is statistically significant in all cases (pooled and individual-country results). Negative sings for compensation are reported in other studies (e.g., Kuhfuss et al. (2016)) and can indicate negative preferences for higher compensation, perhaps as these are associated with higher contract requirements. The size of the standard deviations for the contract characteristics are large when compared to the contract coefficients indicating preference heterogeneity across contracts that cannot be explained from the different contracts (ASCs) or their levels. Results and coefficients' signs vary across countries and their signs and relative sizes correspond with RUT. Overall, longer contracts and high administrative burden decrease the probability of enrolling in a contract over the base levels while shorter contract length and provisioning of advisory support were desirable.

With respect to MRS, converting arable to grassland options was by far the ones that participants asked the most compensation for, across countries. This is an expected result given the large financial commitments and land use changes such a scheme requires. For the other schemes that are already offered under the current CAP in most of the case studies[3] (flower strips, cover crops and maintaining grasslands) the median MRS estimates varied when compared to actual per hectare compensations. For example, MRS for flower strips and maintaining grasslands in the German sample is below the current compensation levels in the country. On the other hand, MRS estimates for the UK sample are mostly higher than the current payment levels in the country, with the MRS estimate for the grassland contract being considerably higher. Overall, most MRS estimates were below or close to the current levels of compensation offered in the CAP countries. Different opinions appear to exist both for the different contract types and contract

[3] Cover crops contracts are not currently available to CZ farmers.

Table 4
Goodness-of-fit measures for different class specifications.

Classes	*Number of parameters*	*CAIC*	*BIC*
2	28	4593.119	4565.119
3	46	4494.342	4448.342
4	64	4435.082	4371.082
5	82	4420.193	4338.193
6	100	4465.99	4365.99

characteristics (i.e., coefficient signs were different across countries), showing large preference variability across these three countries that have been under the CAP for many years.

With respect to contract characteristics, the availability of support made participants willing to offer a 123 Euros/ha/year discount in the asked compensation while longer duration and administrative burden increase MRS by 123 Euros/ha/year and 268 Euros/ha/year in the three CAP-influenced countries. Conversion from arable to grassland was deemed to be quite demanding in German farmers (MRS being the highest in all three countries of approximately 2 k Euros/ha/year) while interestingly, UK farmers were willing to offer discounts in the requested compensation to participate in cover crops and grassland-maintaining contracts, pointing to the existence of higher utility by enrolling in such schemes. Following the recommendation from Mariel et al. (2021) we simulate the MRS distribution using the Krinsky and Robb (1986) method with 10,000 repetitions to examine whether the MRS estimates are plausible. The results of the simulation show that the MRS estimates are indeed meaningful and can be used for informing policy (Mariel et al., 2021) as they correspond closely to the normal distribution. Fig. 3 in the Appendix shows and example of this, using kernel density estimates plotting the CONTRACT1.

Regarding the examination of position order effects, both a non-parametric and a parametric analysis were undertaken, following Nguyen et al. (2021). In the non-parametric analysis that examined if there are differences in accepting any non-opt-out option, acceptance rates were quite similar across the sample that always saw the opt-out option last and the sample that say it in a random position (approximately 13 % in both samples). A Kruskal-Wallis test in the full sample indicated that the mean frequencies of acceptance/enrolment rates across the two blocks are not significantly different from each other, showcasing that there are no overall position order effects observed (p-value < 0.001). The results of the parametric analysis are presented in Table B in the Appendix, show that position ordering effects play a role in accepting specific contracts or characteristics. Negative signs of interaction terms indicate that, when comparing any contract or characteristic with the opt-out, respondents experience decreases in utility. Results in the model with the interaction terms (see Table B in the Appendix) indicate that position ordering effects play a positive role in a participant selecting the contract ARBGRASS and the contract characteristic ADMIN_LOW while having a negative and statistically significant effect on selecting CONTRACT_10 and COMPENSATION. Given the overall sample size, this analysis was not extended in the country level.

Given the large standard deviations in Table 3 indicating preference heterogeneity, a LCM conditional logit model was run following Eq.3. It included multiple variables to account for class membership that reflect previous experience with AES and socio-demographic characteristics of respondents (as described in Table 1) following past studies (e.g., (Tyllianakis et al., 2023; Grammatikopoulou et al., 2016) and assumes existing correlation between random parameters in the model. The LCM conditional logit model captured this by including variables indicating if a participant had previously or is currently enrolled in AES focusing on flower strip creation (FLOWER_EXP) and grassland maintenance (GRASS_EXP), the most common type of schemes across the four CS. The optimal number of classes for the LCM model was selected by using the consistent Akaike's information criterion (cAIC) and the Bayesian information criterion (BIC) (Zhou et al., 2018). Results are presented in Table 4 below, showing that the CAIC and BIC are minimised in the 5-class solution. Results of the LCL model are presented in Table 5 and show that Class 3 and Class 5 participants are not inclined to enrol in AES while Class 1 and Class 2 show stronger preferences to enrol in any of the four AES offered, with only exception being the new ARB_GRASS scheme that Class 2 seem to be less inclined to enrol, indicating an aversion towards new and more demanding AES. Contract characteristics such as duration and administrative burden have similar signs with the MXL model in the AES-inclined classes (Classes 1 and 2). Past experiences with AES focusing on flower strips seem to be driving these two classes while maintaining grasslands decrease the likelihood of a farmer belonging in either Class 1 or 2. Having a successor also increases the probability a farmer is either in Class 1 or 3, which means that such farmers are neither inclined nor disinterested in enrolling in AES. MRS are not estimated for the LCM model as they would not inform EU policy in the context of this paper.

Table 5
Latent Class Logit model with AES-related experience and socio-demographics. ***, **,* denote statistical significance at the 1%, 5% and 10% level respectively.

Pooled sample	Class 1		Class 2		Class 3		Class 4		Class 5	
	Coeff	St. Error	Coeff	St. Error	Coeff	St. Error	Coeff	St. Error	Coeff	St. Error
FLOWER	2.754***	0.783	1.595**	0.704	−3.626***	1.019	0.321	0.952	−0.990***	0.298
COVER	3.502***	0.824	0.711*	0.419	−2.867***	0.929	−0.771	1.198	−0.888***	0.281
GRASS	2.799***	0.811	0.125	0.466	−3.445***	0.947	3.360***	0.799	−0.637***	0.233
ARB_GRASS	3.176***	0.816	−2.573*	1.317	−5.754***	1.204	0.819	.	−2.049	0.237
CONTRACT1	0.165	0.142	0.095	0.272	0.391	0.616	0.514	0.671	0.097	0.252
CONTRACT10	0.117	0.112	−0.899**	0.317	0.124	0.534	0.193	0.590	−0.539**	0.266
SUPPORT	0.406***	0.118	−0.718**	0.320	−0.385	0.568	1.563	1.114	0.421	0.272
ADMIN_LOW	−0.174	0.129	0.362	0.325	1.018	0.688	−0.921	0.868	−0.178	0.301
ADMIN_HIGH	−0.175	0.132	−0.253	0.386	−1.448	1.238	−1.104	1.084	−0.710**	0.324
COMPENSATION′	0.001	0.000	0.001*	0.001	0.003***	0.001	−0.001*	0.001	0.001	0.001
Class Shares										
FLOWER_EXP	2.035**	0.803	2.880***	0.932	3.644***	1.283	−1.374	1.188	–	–
GRASS_EXP	−1.111*	0.600	−2.023***	0.737	−4.990	1.483	1.102	0.737	–	–
EDUCATION	−1.534***	0.505	−0.687	0.543	−2.054	1.233	0.018	0.791	–	–
SUCCESSOR	1.679**	0.765	0.172	1.043	2.495**	1.052	1.308	0.872	–	–
FARM_INC_SOURCE	−0.083	0.517	−0.069	0.664	0.408	0.861	0.448	0.597	–	–
MARKET	−0.428	0.523	0.239	0.645	1.259	0.895	0.232	0.602	–	–
MALE	0.010	0.457	−0.010	0.557	0.016	0.891	0.272	0.592	–	–
Constant	0.578	0.465	−0.175	0.569	−2.198*	1.162	−2.083**	0.878	–	–
Class share	0.392		0.205		0.083		0.106		0.214	

Table 6
Results from the beta-regression on stated % of land enrolled in four hypothetical contracts, over contract characteristics, AES experience and socio-demographics. ***, **,* denote statistical significance at the 1%, 5% and 10% level respectively.

Pooled sample	Flower strips	Cover crops	Grassland	Arable to grassland
Contract characteristics				
COMPENSATION	−0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
CONTRACT1	−0.108	−0.072	0.037	0.071
	(0.069)	(0.079)	(0.053)	(0.106)
CONTRACT10	−0.020	0.009	−0.068	0.006
	(0.072)	(0.071)	(0.055)	(0.095)
SUPPORT	−0.017	−0.085	−0.006	0.014
	(0.070)	(0.065)	(0.054)	(0.088)
ADMIN_LOW	0.031	−0.112	0.020	−0.039
	(0.083)	(0.077)	(0.054)	(0.098)
ADMIN_HIGH	0.146*	0.089	0.116*	−0.077
	(0.057)	(0.077)	(0.063)	(0.104)
Non-contract characteristics				
FLOWER_EXP	−0.123**	−0.007	−0.304***	−0.039
	(0.057)	(0.062)	(0.054)	(0.080)
GRASS_EXP	−0.034	0.103*	−0.133***	0.465***
	(0.055)	(0.061)	(0.045)	(0.083)
SUCCESSOR	0.135**	0.405***	0.441***	0.334***
	(0.066)	(0.062)	(0.045)	(0.073)
OTHER_SOURCE_INCOME	0.423***	0.288***	0.546***	−0.253*
	(0.067)	(0.082)	(0.049)	(0.130)
FARM_INC_SOURCE	0.659***	0.794***	0.377***	0.142
	(0.077)	(0.094)	(0.065)	(0.129)
MALE	−0.473***	−0.506***	−0.298***	−0.476***
	(0.055)	(0.064)	(0.040)	(0.085)
EDUCATED	−0.307***	0.122*	0.224***	−0.569***
	(0.067)	(0.068)	(0.056)	(0.117)
μ	−0.443	−1.241*	0.066	0.272
	(0.653)	(0.362)	(0.482)	(0.984)
Intercept	−0.506	−1.087***	−0.492***	−0.011
	(0.243)	(0.294)	(0.188)	(0.380)
Scale	1.512***	2.281	2.281***	1.495***
	(0.038)	(0.188)	(0.041)	(0.052)
Observations	1,145	790	1,110	620
Log-Likelihood	228.16031	240.05234	558.37476	130.38712

4.2. Drivers of land enrolled in agri-environmental schemes

Finally, to examine the drivers behind choosing the percentage of the land they manage to enrol in any of the four contracts (that is, excluding a farmer choosing the no-scheme option), a beta regression (preferred over the ordinary least squares regression) was run over all contract characteristics and socio-demographics (derived from Eq. (4), following Vaissière et al., (2018). The pooled sample is convenient for this step due to the similarity in policies and expected uniformity around preferences and experiences for AES. To comply with the needs of the beta regression, 5 respondents were removed as they had an average of either 0 or 100 % in their average stated percentage of land enrolled either grassland or arable in all six choice cards. The remaining 245 responses (filtered as described in Section 3) were analysed, and the results are presented in Table 6 below. Overall, in 3,665 choices, participants stated that they would enrol on average 43 % of their land in any of the suggested AES, significantly lower than the 79 % reported in Vaissière et al., (2018). The most land was stated to be enrolled in cover crops (47 %) and the least in converting arable land to grassland (42 %) but the other two options were chosen more often (maintaining flower strips and maintaining grasslands) and therefore contain more observations. Fig. 2 shows the geographical spread of responses, according to the mean stated enrolled area from a respondent, across the six options.

Interestingly, contract characteristics have no statistical significance on the percentage of land enrolled in any of the four proposed contracts apart from the positive effect of ADMIN_HIGH in flower strip and grassland contracts. Instead, past experience with AES and socio-demographics have a strong and statistically significant effect. Having enrolled in the past in flower strips AES (FLOWER_EXP) had a negative impact on land enrolled in any AES contract, while past experience with maintaining grasslands (GRASS_EXP) had a positive effect in percentage of land enrolled in cover crop and converting arable land to grassland contracts (and a negative impact on maintaining grassland contracts). Having a higher education (EDUCATED) resulted in stating lower percentage of land to enrol in flower strips contracts and converting arable to grassland AES and a positive impact on cover crops and maintaining grassland contracts. Having a farm successor (SUCESSOR) has a positive impact on percentage enrolled in all contracts while male farmers appear to be willing to enrol smaller pieces of land to AES than female ones. Finally, farmers that have at least 50 % of their income from farming (FARM_INC_SOURCE) are more likely to enrol more land in any of the four hypothetical AES, as well as those who have a second source of income (OTHER_INC_SOURCE) (apart from enrolling in contracts converting arable land to grassland).

5. Discussion

This study examines the applicability of a DCE in the context of a multi-country experiment aiming at determining farmers' preferences for existing and new AES. DCEs have been consistently found to be informative of informing decision-making in the field of AES, both in terms of contract characteristics and facilitating cost-effective interventions (Schulze et al., 2023). In this article, farmers have different preferences for four different schemes and their contract characteristics as can be seen by the different signs in contract characteristics across countries in Table 3 with preference heterogeneity evident across the three countries. Existing agri-environment contracts (flower strips, cover crops and maintaining grasslands) were well-perceived by

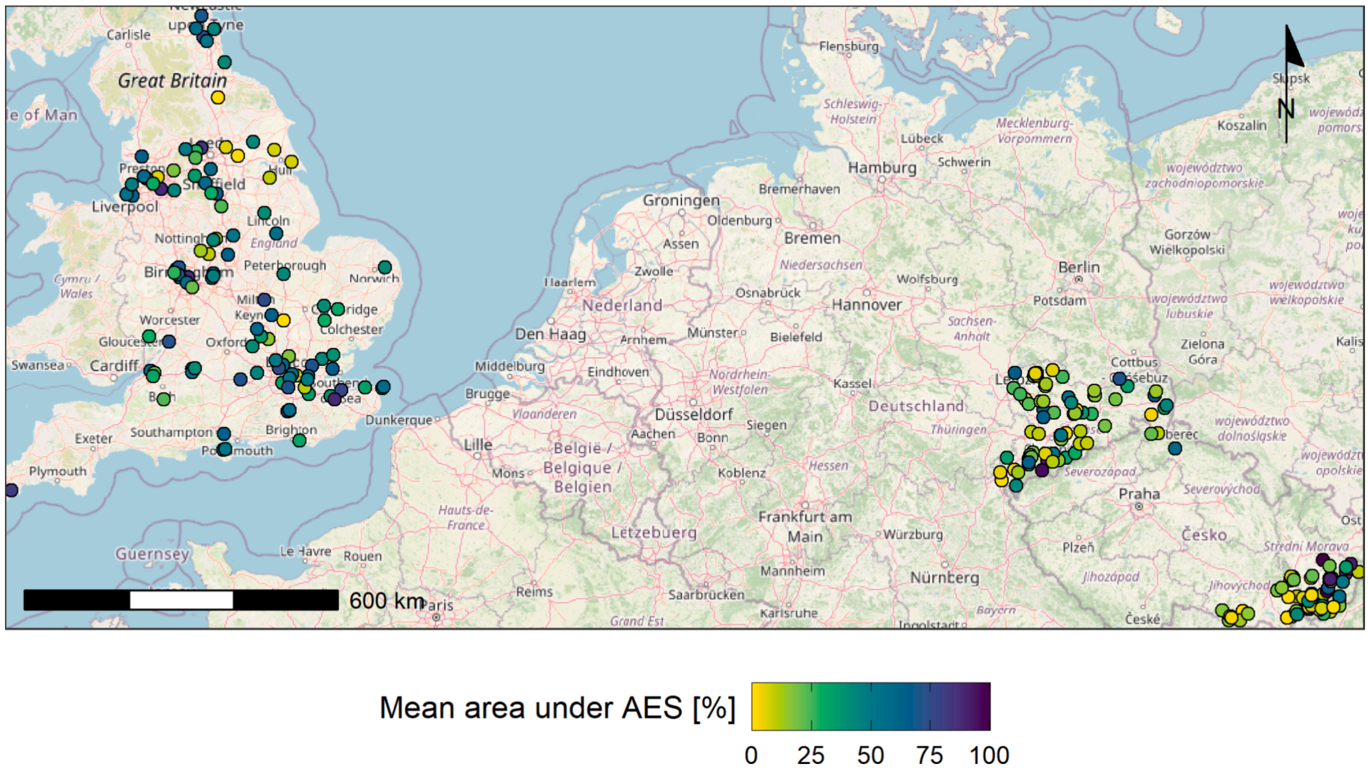

Fig. 2. Mean percentage of area stated to be enrolled, across countries and different schemes.

participants while the more commitment-intensive scheme of converting arable land to grassland was less desirable. Such findings are consistent with past studies in these countries, for example, Bartkowski et al., (2023) find that Czech farmers prefer the flexibility of shorter contracts to allow them to cancel measures based on market or environmental changes. 10-year contracts are less preferred than 1-year contracts, when compared to the baseline which showcases an aversion towards long-term commitment to agri-environmental activities, similar to other studies (e.g., Schulz et al., 2014; Niskanen et al., 2021) which can be linked to length of land tenure being longer than AES contracts in the UK (3.66 years in the UK, Cardwell, 2023) and Germany (it is legally prohibited for German farmers to convert permanent grassland over than 5 years, Bartkowski et al., 2023).

As expected, it appears that farmers would require high amounts of compensation to be convinced to enter such schemes (see MRS results in Table 3). This appears to be foreseen by the European Commission's aim to increase the rural development budget (through 35 % of CAP funds ring-fenced to support climate and biodiversity, among others) (European Commission, 2019). The provisioning of advisory support uniformly decreases the requested compensation across all countries, similar to the findings in review studies of European AES (Tyllianakis and Martin-Ortega, 2021) and qualitative studies (e.g., Emery and Franks, 2012; Morgans et al., 2021; Bartkowski et al. 2023). Bureaucracy and scheme complexity are considered by farmers as large deterrents when considering AES enrolment (Birge et al., 2017). The stated discount levels for when support is offered could be used to offset higher payments for farmers reluctant to enrol in lengthy contracts, similar to Tyllianakis and Martin-Ortega (2021). Grouping respondents based on past experience and socio-demographic characteristics shows that past experience with flower strip AES increases enrolment while past experience with grassland AES decreases it (see Table 5). More than 50 % of the sample appears more inclined to enrol in any of the four AES offered (Classes 1 and 2 in Table 5) while around 30 % of respondents appear to not prefer any of the four contracts but still be influenced by contract characteristics such as contract duration and administrative burden (Classes 3 and 5 in Table 5).

Regarding the estimated marginal rates of substitution for different contracts and characteristics (see MRS columns in Table 3), estimates varied across countries in our results. Overall, few studies exist that estimate land managers' preferences and MRS for contracts such as flower strips creation or grassland maintenance. Christensen et al. (2011) estimate a mean willingness to accept (WTA) of 43 Euros/ha/year for pesticide-free buffer zones (that provide similar benefits to flower strips/areas) in Denmark. Regarding conservation of grasslands, few studies exist that report marginal WTA and our estimates are comparable with this literature (e.g., Šumrada et al. (2022) report WTA estimates between 200 and 500 Euros/ha/year). Existing payment levels for maintaining grasslands are within the range of our country-specific findings, for example, farmers maintaining grasslands within Natura 2000 areas in Flanders, Belgium receiving around 1000 Euros/ha/year and 1200 Euros/ha/year for converting arable to grassland (Lizin et al., 2015). These estimates are well below the per hectare payment reported from the cross-EU farmer survey of Zimmermann and Britz (2016) indicating a disparity between the desired levels of compensation (described through MRS/WTA estimates) and actual payment levels.

Considering contract characteristics, our three country results (see the first MRS column in Table 3) are very similar to the literature with respect to accepting a discount for shorter contract duration reported by a range of studies[4] (e.g., Christensen et al., 2011; Santos et al., 2015; Vaissière et al., 2018). The change in MRS with provisioning of support is smaller than that of 52 Euros/ha/year reported by Christiansen et al., (2011), perhaps indicating of the increased bureaucratic burden placed on farmers as multiple agri-environment contracts exist and are subject

[4] Christensen et al., (2011) report a mean WTA of 123 Euros/ha/year for 1 year versus 5 year contract duration, Santos et al., (2015) report a mean WTA of 304, 459 and 770 Euros/ha/year for 5, 10 and 20 years respectively of a contract aiming at conserving a mountainous ecosystem in Portugal while Vaissière et al., (2018) report a mean WTA of 63 Euros/ha/year for an extra year of contract).

to regular alterations from regional governments. This finding can be further reinforced by the size of mean MRS estimate if a contract has high administrative burden for the farmer. Our pooled 3-country estimate of 268 Euros/ha/year (Table 3) is double the size of the estimates in Chèze et al., (2020) that define administrative burden jointly with the type of contract and the provision of subsidy as part of a contract. Although required payments are high in our results, they are not uncommon in surveys of European farmers examining estimated cost of land use changes in agricultural practices (e.g., Lizin et al., 2015) and find support in Bartkowski et al. (2023) which claims that economic considerations, particularly opportunity costs, are the main reasons affecting AES adoption in all three countries. Additionally, administrative burden of farmers has been previously documented as a major stressor for farmers having to follow strict deadlines and cut-off dates in all three case studies (Bartkowski et al., 2023; Wittstock et al., 2022), increasing calls for increasing of information made available to farmers (Mack et al., 2019).

Turning to the drivers of land enrolled in AES, our results are in line with the DCEs examining factors influencing enrolment in hypothetical AES-literature (e.g., Ruto and Garrod, 2009; Espinosa-Goded et al., 2010; Hasler et al., 2019) and indicate that the decision to enrol is not dependent on contract characteristics (such as deciding the land enrolled in a scheme) but it depends on personal and farm-related characteristics, similar to other DCE studies (e.g., Tanaka et al., 2022). Our results in Table 6 show that being a female farmer (Defransesco et al., 2008), having a named successor and selling the majority of one's products to a local market (Latacz-Lohmann and Breustedt, 2019) increases the percentage of land enrolled. During the second stage of the analysis, past experience with flower strips or past experience with grassland-maintaining AES had a negative impact on land enrolled, inline with the first-stage choice to enrol in the four AES (see results in Tables 5 for all classes). Other studies looking into preferences and perceptions for AES aiming at increasing biodiversity (in our study captured by flower strips/areas contracts) report similar effects of past experience (Herzon and Mikk, 2007; Defransesco et al., 2008; Espinosa-Goded et al., 2010). Our study did not focus on the years of experience with AES which have been found to increase the rate of AES adoption (Wynn et al., 2001). High administrative burden had a somewhat surprising positive effect in land enrolled in cover crops and grassland contracts, possible correlated with the expectation of farmers that high administrative burdens are expected in contracts that could require to join land parcels (Vaissière et al., 2018) to increase land enrolled in an AES. It appears though that practical choices regarding land enrolled in AES are driven more from elements that farmers have more control over such as being a full-time farmer and having other sources of income apart from farming to supplement tying down land into an AES. Additionally, having a successor in one's farm can also reduce uncertainty and therefore allow for committing more land to come under subsidies (Lastra-Bravo et al., 2015).

Finally, we find some evidence for position ordering effects in the full model affecting preferences for contract characteristics and types of contracts but not influencing choosing the opt-out option (see Appendix B). Although position ordering effects are often reported in willingness to pay studies (e.g., Carlsson et al., 2012; Day et al., 2012; Nguyen et al., 2015) they are absent from studies examining producers' preferences for accepting compensation. Position-ordering effects might reveal nonstable preferences across sequences of choices (Day et al., 2012) and in this study position-ordering effects appear to weakly influence preferences for the level of compensation with stronger influence on contract duration and administrative burden but not making respondents more or less likely to not enrol in AES. Using the theories of preference formation in Day et al. (2012) we can identify the following effects of position ordering effects as compatible with an MRS setting: preference learning (changing preferences for non-compensation attributes) and anchoring effects (focusing on current levels of compensation/hectare). As farmers are expected to be aware of contract structures and payment levels, issues such as institutional learning are not expected to influence farmer valuation surveys.

There is a rich and growing literature on the topic of determining the drivers and antecedents of choices and decisions regarding agri-environmental schemes made by European land managers which were not covered in this study. For example, empirical approaches to understanding pre-existing viewpoints regarding environmental management and concepts of stewardship, as well as patterns within them are becoming more common (e.g., Walder and Kantelhardt, 2018; Norris et al, 2021). Farmers' identities and archetypes (structured through socio-demographic and psychological characteristics) have also been found to help explain adoption of agri-environmental schemes (Leonhardt et al, 2022; Tyllianakis, 2023). More evidence has been produced regarding drivers of adoption of agri-environmental schemes with studies focusing on quite divergent contract characteristics. Some contract characteristics are more commonly examined than others (such as monitoring, support and contract length, see Tyllianakis and Martin-Ortega, 2021 for a review) but nevertheless no contract feature apart from compensation are examined from the majority of the literature (Rodríguez-Entrena et al., 2019).

Further research focusing both (and not separately) on drivers of adoptions *and* land enrolled in an agri-environmental contract is therefore required. Some aspects of survey dissemination might have also influenced results, such as using a "slider" that participants were using to indicate their preferred percentage. It is likely that participants indicated percentages in a "ballpark" manner and therefore we refrain from interpreting results further, apart from commenting on statistical significance of the regression's covariates. Strategic behaviour from the part of participating farmers is also possibly affecting results (Lizin et al., 2015), for example, if participants do not believe that they will be paid the described amount or if they believe that by selecting higher payment levels they could influence an eventual policy or agency in offering higher payments. Finally, the S-efficiency criterion used at the experimental phase depends more on the prior values and therefore the cross-country nature of the analysis and the size of the pre-test responses might have influenced results.

6. Conclusion

The EU's continued focus on delivering public goods through agriculture through the introduction of eco-schemes in the new CAP is following an existing trend of increasing investment in AES. Participation in these voluntary schemes varies from country to country and is dependent on a wide variety of farmer characteristics and farm-related characteristics. The amount of land farmers state to be willing to enrol in a scheme is expected to be a separate decision from indicating preference to enrol in a scheme. In a cross-country survey amongst European farmers, we examined the influence of various existing and new schemes on adoption, contract characteristics such as contract length, advisory support, level of administrative burden and compensation alongside farm-related characteristics. Such characteristics referred to prior experience in enrolling in AES as well as key socio-demographic characteristics. Results show a variant picture across Germany, Czech Republic and the UK with contract features influencing preferences differently is each country, as well as significant heterogeneity in preferences. Past experiences with schemes supporting the creation of flower strips increase likelihood of enrolment while schemes paying to maintain grasslands decrease it. When examining the drivers behind the percentage of land to enrol in a chosen scheme, similar to other studies (e.g., Latacz-Lohmann and Breustedt, 2019), we find that contract characteristics do not affect land enrolled; instead past experiences with schemes maintaining flower strips and grasslands play an important, as does having a named successor, other sources of income apart from farming as well as being primarily involved in farming as an occupation. The order of presenting such hypothetical options to farmers is also found to influence contract preferences but not overall enrolment in schemes.

The rich mosaic that is EU agriculture therefore requires solutions tailored not only at the country level but also perhaps at the farm-type level. Compensating farmers for enrolling in AES is important but offering desirable contract features (such as including advisory support and short-term contracts) can make farmers accept discounts in compensation. Failure to do so will make farmers ask for much higher compensation, per hectare, potentially to cover costs of transitioning to different types of farming or to incorporate financial risk by significantly altering their farm practices. Finally, further research is required to determine whether stated preferences and intentions to enrol land in AES are comparable with enrolment in new CAP schemes, given the high goals set by the EC to make EU farming carbon neutral by 2050 and increase funding to voluntary environmental support schemes.

CRediT authorship contribution statement

Emmanouil Tyllianakis: Writing – original draft, Software, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Meike Will:** Visualization, Software, Formal analysis, Data curation, Conceptualization. **Tomáš Václavík:** Writing – original draft. **Guy Ziv:** Writing – original draft, Funding acquisition.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table A
Full list of payment levels.

Germany (EUR/ha)[1]					
Flower areas/strips	630	735	840	945	1050
Cover crops	65	75	85	95	105
Maintaining grassland	240	285	330	375	420
Conversion of arable land to grassland	1200	1400	1600	1800	2000
UK (£/hectare/year)[2]					
Flower areas/strips	410	550	620	690	825
Cover crops	90	120	135	150	180
Maintaining grassland	140	190	215	240	285
Conversion of arable land to grassland	800	1100	1250	1400	1665
Czech Republic (EUR/ha) [3]					
Flower areas/strips	450	525	600	675	750
Cover crops	65	75	85	95	105
Maintaining grassland	140	165	190	215	240
Conversion of arable land to grassland	900	1050	1200	1350	1500

[1]Source: Sächsisches Staatsministerium für Energie, Klimaschutz, Umwelt und Landwirtschaft. (2015) Förderrichtlinie Agrarumwelt- und Klimamaßnahmen – FRL AUK/2015. Available at: https://www.smekul.sachsen.de/foerderung/download/Foerderrichtlinie-Agrarumwelt-und-Klimamassnahmen-.pdf.
[2]Source: Defra, available at: https://www.gov.uk/countryside-stewardship-grants.
[3]Source: Ministry of Agriculture of the CR (2019): Methodology for the implementation of Government Regulation No. 75/2015 Coll., on the conditions for the implementation of agri-environment-climate schemes and on the amendment of the follow-up Government Regulation No. 79/2007 Coll., valid for 2019. Available at: https://eagri.cz/public/web/mze/dotace/program-rozvoje-venkova-na-obdobi-2014/opatreni/m10-agroenvironmentalne-klimaticke/metodika-aeko-2019.html.

Table B
Results from a mixed logit model with interaction terms examining position ordering effects. □: value of the natural logarithm. ***, ** denote statistical significance at the 1 % and 5 % level respectively.

Pooled sample	Coeff	St. Error
FLOWER	−0.124	0.204
COVER	0.147	0.163
GRASS	0.167	0.162
ARB_GRASS	−2.447***	0.376
CONTRACT1	0.053	0.140
CONTRACT10	0.056	0.147
SUPPORT	0.218	0.165
ADMIN_LOW	−0.422***	0.156
ADMIN_HIGH	−0.670***	0.175
COMPENSATION′	−6.968***	0.262

(continued on next page)

Table B (*continued*)

Pooled sample	Coeff	St. Error
Interaction terms – position ordering effects		
FLOWER	0.399	0.366
COVER	0.045	0.235
GRASS	0.258	0.250
ARB_GRASS	1.989***	0.633
CONTRACT1	0.191	0.206
CONTRACT10	−0.466**	0.200
SUPPORT	0.144	0.236
ADMIN_LOW	0.571***	0.212
ADMIN_HIGH	0.308	0.242
COMPENSATION′	−0.001***	0.000
Standard Deviations		
CONTRACT1	0.732***	0.144
CONTRACT10	0.624***	0.155
SUPPORT	0.976***	0.133
ADMIN_LOW	−0.049	0.234
ADMIN_HIGH	0.549***	0.189
COMPENSATION′	0.944***	0.150

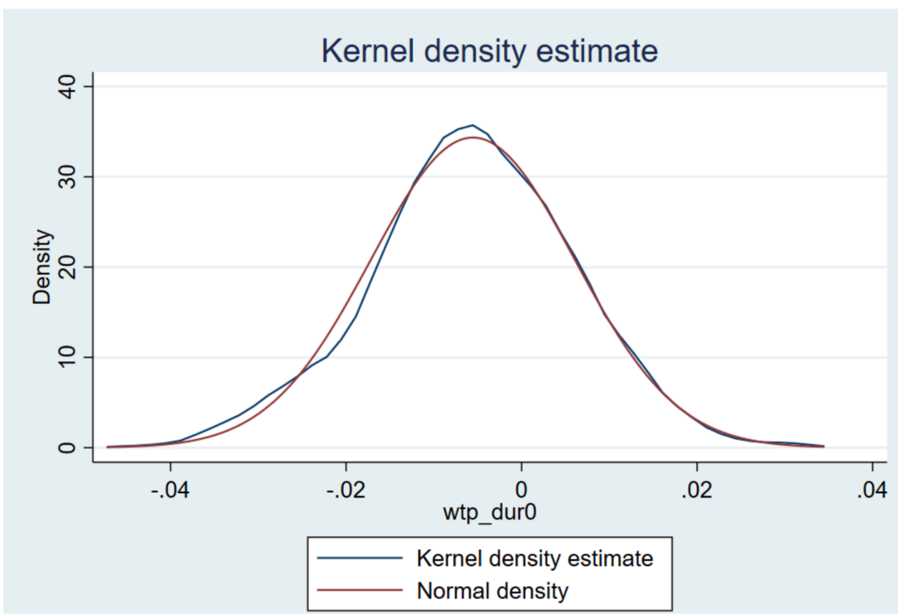

Fig. 3. Kernel density estimates of the simulated distribution of CONTRACT1 MRS values**Declaration of interests**

Data availability

The data that has been used is confidential.

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