Farmers’ preferences over alternative AECS designs. Do the ecological conditions influence the willingness to accept result-based contracts?

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Abstract

Agri-environmental-climate schemes provide payments for ecosystem services by compensating farmers to implement management actions or obtain ecological results. To compare farmer preferences for action-based schemes, result-based schemes, or a hybrid, we conduct a discrete choice experiment in a case study from Germany. We elicited farmers’ choices for alternative grassland biodiversity payments through an in-person survey and measured farms’ ecological performance using a biodiversity index. Results reveal that neither the payment mechanism nor its amount is a primary driver of farmer decision-making. Instead, the applicability of the prescribed management practice to the farming system, and the achievability of the outcome, are key for uptake. Intensive farmers are more likely to choose hybrid-based solutions than extensive farms, which prefer a result-based approach. Farms with higher biodiversity tend to accept result-based schemes more frequently and are willing to enrol a greater share of their land. Our findings suggest a potential lack of additionality but also that farmers’ awareness about their farms’ ecological potential influences uptake of result-based schemes. To encourage farmers participating and enroling more land in these schemes, policy-makers should tailor the payment-mechanism to different farmers and provide in-site technical advice.

Key words
Choice Experiment, Agri-Environmental-Climate Schemes, Result based, Biodiversity

JEL Code

Q18 Agricultural Policy; Food Policy; Animal Welfare Policy Q57 Ecological Economics

1. Introduction

Agri-environmental-climate schemes (AECS) are Payment for Ecosystem Services (PES) initiatives touted as a means to support the transition to a more sustainable agricultural system by boosting farmers' provision of environmental goods and services. Under the European Union's Common Agricultural Policy (CAP) reform 2023 – 2027, agricultural ministries across the EU increased the budget designated for these instruments and moved several of them as eco-schemes in the first pillar (EC 2021). The increased overall expenditure for environmental payments, however, does not solve the main issue of AECS: they are criticized for not always being cost-effective and able to trigger the expected behavioural response from farmers (Hasler et al. 2022; Pe'er et al. 2020).

Payment for Ecosystem Services schemes have been shown to be inefficient if there are information asymmetries about the costs to farmers (Engel et al. 2008; Hanley et al. 2012). If farmers are not properly compensated for their provision of environmental goods and services, the payments may not be cost-effective and will fail to induce a socially desirable level of adoption (White and Hanley 2016). Moreover, if the right farmers are not targeted, there might also be adverse selection by paying farmers who would have adopted the practice regardless of the payment (Wunder et al. 2020). In such cases, payments are provided for results that would have been achieved also under (no scheme) conditions. This means low additionality for the initiative (Martin Persson and Alpízar 2013). Imperfect information affects also transaction costs, namely the costs faced by regulators and farmers to gather adequate information or monitor and enforce (Mettepenningen et al. 2011).

The scheme's design is considered one of the key drivers of the scheme's performance (Börner et al. 2017). Critical is the regulators' choice between an action or a result-based approach (Hanley et al. 2012; White and Hanley 2016). In the first case, farmers are paid to implement pre-defined farming practices expected to reduce negative environmental externalities. In the second case, farmers must demonstrate positive ecological results, which are normally measured based on different indicators, such as the presence of plant species, breeding success of farmland birds or reduction of pollutants in soils or watersheds (Herzon et al., 2018).

From an economic standpoint, paying farmers for ecological outcomes is considered more efficient than compensating farmers for management practices (Gibbons et al. 2011; White and Hanley 2016). This approach ensures ecological outcomes and gives the farmers the flexibility to undertake management actions that fit their context and are cost-efficient. By measuring results, farmers are also incentivized to select land where ecological results are more probable and, in the case of a baseline assessment, land where results are additional (Bartkowski et al. 2019).

Despite these advantages, research has shown that result-based payments also have practical drawbacks, some of which deter farmer participation (Russi et al. 2016; Birge et al. 2017; Herzon et al. 2018). These include, among others, higher risks for farmers and increasing transaction costs (Bartkowski et al. 2019; Burton and Schwarz 2013). In result-based schemes, farmers assume responsibility for an environmental outcome that depends not only on their management but also on other external factors (e.g. weather) (Ayambire and Pittman 2021; Burton and Schwarz 2013). To overcome such limitation, studies suggest that payments must be high enough to compensate for the risk or include some form of risk control (Loisel and Elyakime 2006; Schwarz et al. 2008). For instance, a hybrid scheme could split the compensation payment between a guaranteed element for participation and a top-up payment upon delivery of the desired outcome (Burton and Schwarz 2013; Schwarz et al. 2008). In terms of transaction costs, to address the increasing costs of measuring farm-level ecological conditions, some regulators have proposed to shift the verification obligation, thus the cost, on farmers (Herzon et al. 2018).

Different pilot initiatives have been gradually tested and introduced for result based agri-environmental-climate schemes in Europe (EC 2022). Many of these pilots have concentrated on biodiversity in grassland habitats as there are relatively clear ecological indicators (Herzon et al. 2018). Accordingly, the body of literature that empirically investigates the effects of and farmer preferences for result-based schemes is growing. Different studies have explored qualitatively (Schroeder et al. 2013; Birge et al. 2017; Wezel et al. 2018) or quantitatively (Vainio et al. 2021; Massfeller et al. 2022; Tienhaara et al. 2020) the perceived legitimacy of hypothetical payments on results. A few studies have qualitatively investigated ex-post drivers of participation in pilot schemes (Matzdorf and Lorenz 2010; Fleury et al. 2015; Russi et al. 2016). More recently, (Niskanen et al. 2021; Šumrada et al. 2022; Tanaka et al. 2022)) have used discrete choice experiments (DCE) to reveal ex-ante farmers' attitudes toward the introduction of hypothetical result-based payments. While Šumrada et al. (2022) look at farmer preferences between action and result-based approaches, Tanaka et al. (2022) investigate how different contract attributes influence willingness to accept a result-based payment. On the other hand, Niskanen et al. (2021) examine the heterogeneity of farmer preferences for the approach. In particular, Šumrada et al. (2022) elicited farmer preferences in two Natura 2000 sites in

Slovenia for different contract elements of a grassland conservation scheme. They found that most farmers living in these sites, mainly small and semi-subsistence farmes, preferred the result-based approach. Similarly, Tanaka et al. (2022) found that rice farmers in Japan are willing to participate in contracts based on results and that a variety of contract attributes, such as payment, ecological outcome, and monitoring approach, influence farmer decisions. Finally, using latent class analysis, Niskanen et al. (2021) revealed that responses to results-based schemes differ between farmer groups, with the distinction in farm structure being the reason for the heterogeneous preferences.

While these studies investigated result-based payments, they have not yet investigated preferences for a hybrid scheme and how farmers valuate the tradeoff between the three approaches. Also, no study has tried to understand how pre-existing farm ecological conditions relate to farmer preferences and can influence land allocation decisions. This presents two important gaps in the literature that this paper tries to address. First, it aims to understand farmer preferences for hybrid schemes and their attributes, to contribute to the debate on whether to pay farmers for results, actions, or both. Second, considering the additionality problems dominating agri-environmental-climate schemes, it explores how farmer preferences relate to actual farm-level ecological conditions. If farms in better ecological conditions show a higher interest in result-based approaches, this could suggest low additionality in the absence of baseline measurements.

To address these gaps, we apply a discrete choice experiment (DCE) to the Federal State of Bavaria (Germany), where a result-based pilot scheme for grassland extensification was introduced in 2015. Due to the pilot scheme, farmers were already familiar with result-based payments when we did our study, which allowed us to reduce possible cognitive bias associated with the hypothetic choice. Also, building on the list of indicator species from the pilot program (LfL 2014), we created a measure of farm-level biodiversity to uniquely assess farm ecological performance and test whether farmers with greater biodiversity are more inclined to accept result-based schemes.

The remainder of the article is structured as follows. First, we describe the theoretical framework and our hypotheses (Section 2). Section 3 presents our case study, data collection and empirical strategy. Section 4 describes the results from the discrete choice experiment, followed by a discussion and policy implications of our findings (section 5). Finally, the concluding remarks are included in Section 6.

2. Theoretical framework

Agri-environmental-climate schemes (AECS) are payments made to farmers conditional on rules of natural resource management or generation of environmental services. They represent a voluntary transaction between service users (or agencies acting on their behalf) and service providers (farmers). A feature making these policy instruments fall within the broader category of Payments for Ecosystem Services (PES) (Wunder 2015).

According to PES literature, under the assumption of low uncertainty and perfect information about farm types, the regulators can achieve cost-effectiveness under both action- and results-based schemes (Hanley et al. 2012; White and Hanley 2016). In the real world, however, regulators lack information about each farmer's marginal supply prices for environmental goods and the ecological potential of each land area. As gathering farm-level information and developing personalized payments based on farmer opportunity costs is impossible, uniform payments are necessary. However, farmers face different costs for the provision of ecosystem services (Latacz-Lohmann and Breustedt 2019). This can lead to several problems. In particular, if the cost opportunity is too high for most farmers, there may be low adoption rates and only farmers who would have adopted the practice regardless of the payment would participate (Martin Persson and Alpízar 2013). Additionally, if proper monitoring of farmer compliance is too costly, the authority might decide to lower the surveillance at higher risk of moral hazard (Latacz-Lohmann and Breustedt 2019; Gómez-Limón et al. 2019).

When regulators have imperfect information, result-based schemes are considered more efficient in achieving ecological objectives (White and Hanley 2016). Farmers, who have the knowledge, can optimally decide which land to enrol in the payment scheme and use for agricultural production. This makes the production of ecosystem services a more integral part of the farming system, ensures diversification, and reduces the lack of compliance (Burton and Schwarz 2013). Also, results-based schemes can be more appealing from a farmer's perspective. They give the farmers the flexibility to undertake management actions that fit their context and achieve the best results in the most cost-efficient manner (Wezel et al. 2018). However, they also shift the risk of achieving the ecological objective from the regulator to the farmer (Matzdorf and Lorenz 2010; Hanley et al. 2012). Several factors determine conservation outcomes, some of which may lie outside the farmers' control (e.g. weather). As a result, more vulnerable and risk-averse farmers' would be less likely to participate (Loisel and Elyakime 2006; Ayambire and Pittman 2021). In the face of these challenges, Matzdorf and Lorenz (2010) observed that farmers might prefer a combination of results and action-based approaches. Also, from an economic perspective, these hybrid solutions have shown to offer high welfare gains (Derissen and Quaas 2013; White and Hanley 2016). In our experiment, we build on this literature and test whether, faced with the three alternative approaches, hybrid schemes are, in effect, preferred by farmers.

Additionality needs to be high for payments for ecosystem services. From an economic perspective, the payments should encourage a positive behavioural change (or discourage a negative one) that would not have occurred in their absence (Martin Persson and Alpízar 2013; Wunder et al. 2020). Result-based schemes are considered to increase additionality by incentivizing farmers to provide ecological outcomes and enrol land where the results are additional to the baseline (Derissen and Quaas 2013). This is mainly if environmental conditions are measured before and after enrolment (Bartkowski et al. 2019). In the absence of such a prior baseline, farmers' would most probably operate as in action-based payments. They would enrol only the land with lower opportunity costs and, eventually, the areas meeting the required ecological conditions even without the scheme (Bartkowski et al. 2019; Russi et al. 2016). However, setting a baseline is not completely desirable from the regulator's perspective. It would lead to increased transaction costs and potential moral hazard (e.g. creating an incentive to downgrade land before entering the scheme) (Cullen et al. 2018; Bartkowski et al. 2019). The potential additionality of result-based schemes has not been assessed so far. We thus use the results of the discrete choice experiment to investigate farmers' land allocation decisions and verify whether the pre-existing ecological state is likely to affect farmer preferences. Our hyphotesis is that in the absence of baseline assessments, farms' with better ecological status are more likely to participate in outcome based type of schemes.

Finally, different contract characteristics influence farmers' acceptance of payment for ecosystem services schemes. While some contract attributes seem to positively affect the probability to participate (e.g. monetary attributes), others have shown contrasting evidence (e.g. prescription attributes) (Mamine et al. 2020; Raina et al. 2021). For result-based contracts, one main challenge is identifying reliable and measurable outcome indicators (Matzdorf et al. 2008). Reliability refers to the capacity to detect the improvement of the ecological situation on a farm. For instance, in the case of schemes for extensively used grassland, the presence of a certain number of flowering species has been used as a criterion to describe the quality of grassland sites (Matzdorf et al. 2008). A threshold is then chosen based on ecological and acceptability considerations. To encourage participation, the latter has to be realistically achievable. The higher the requirements, the lower might be farmers' interest in adopting the scheme (Herzon et al. 2018). Regarding measurability, it is critical to consider that farmers' self-monitoring is among the most common approaches adopted for the verification of result-based schemes (Burton and Schwarz 2013). This means that farmers directly control the presence of outcomes and transmit the information to the regulator. From a dynamic perspective, self-monitoring might have positive returns, as it increases farmers' self-assessment, adaptive management and awareness (Fleury et al. 2015; Matzdorf and Lorenz 2010). However, it also means farmers' increased private participation costs. Under the assumption that farmers prefer to uptake contracts where little time is spent on administration (Ruto and Garrod 2009; Ducos et al. 2009) self-monitoring reduces the probability of participating. This would mean that regulators would need to set an appropriate payment level to reflect the total cost of achieving the desired outcomes, including time spent on training and monitoring of ecological results by farmers (Herzon et al., 2018).

3. Materials and methods

3.1. The case study

We focus on farmers who manage permanent grassland and satisfy the requirements to participate in grassland extensification agri-environmental-climate schemes in the German federal state of Bavaria. Bavaria is among the core regions for agricultural production in the European Union, with a variety of agri-ecological conditions, ranging from highly elevated (pre) alpine areas to low flat lands and hill-side zones. As the agri-ecological conditions determine the respective farm structures and practices to a large extent, and align with our ecological indicator, we sample farms according to the main agri-ecological zones (StMELF 2022b).

Grassland accounts for 35% of Bavaria’s utilized agricultural area (StMELF 2022b). It is primarily used for the production of fodder (i.e. production of milk and meat) as well as biogas in recent years (LfL 2014). Permanent grasslands provides habitat for a wide range of species and play a central role in protecting soil and groundwater (Wilson et al. 2012; Power 2010; Öckinger and Smith 2007). However, these ecosystem services are increasingly threatened by intensification and abandonment (Habel et al. 2013; Wilson et al. 2012; Vogt et al. 2019; Wesche et al. 2012).

The Bavaria Rural Development Programme attempts to revert this trend by funding, among others, measures for grassland extensification. It includes two sub-programmes: the Cultural Landscape Programme (*de*: Kulturlandschaftsprogramm - KULAP) and the Nature Conservation Programme (*de*: Vertragsnaturschutzprogram – VNP), with the latter targeting farms in nature conservation areas only. Since the Cultural Landscape Programme is the core funding instrument of Bavarian agri-environmental policy and includes a larger number of farmers, we followed (Tzemi and Mennig 2022)) and used it as the reference framework for our study. The Programme offers a broad variety of voluntary measures, both for arable land and grassland, which aim to control pollution, conserve biodiversity, improve animal welfare and maintain landscapes (StMELF 2022a). Farmers are typically offered five-year contracts, and receive a compensation to cover forgone income (and/or additional costs) caused by the specified farming practices. In 2015, the programme introduced a plot-level pilot result-based scheme for maintain grassland biodiversity (B40), which runs in parallel with an action-based scheme (B41) (Table 1). During the programming period 2015-2022 the Cultural Landscape Programme pursued further grassland extensification efforts by compensating farmers for limiting livestock density (B19 and B20) and maintaining sensitive areas and old grassland strips (B30 and B42).

In the same period, both the result-based (B40) and the action-based (B41) schemes offered a per hectare payment of 250 €. Under the action-based scheme (B41), the farmers received the payment if they abide by the ban of mowing until July 1st. Under the result-based scheme, farmers receive the payment if on the enroled plot there were at least four grassland biodiversity indicator species from a list of 34 flowering species (or groups of species) developed by the Bavarian State Institute for Agriculture (LfL 2014). The species are easily recognizable so that farmers can identify them every year on their own, without the need for constant monitoring from authorities (Lfl, 2014). Our hypothetical scenario was inspired by the Cultural Landscape Programme. For instance, the result-based scheme builds on the existing B40, while the design of the action-based scheme aligns with the current offer (B20 and B41). The hybrid option combines features of both schemes.

Table 1. Agri-environmental-climate schemes for extensive grassland use in Bavaria (KULAP 2015-2022)

AECS code	Prescribed management practice	Ecological results	Compensation payment
B19	Maximum LU (1.0 LU/ha) No mineral fertilization	None	220 €/ha
B20	Maximum LU (1.4 LU/ha) No mineral fertilization	None	169 €/ha
B30	In sensitive areas: no fertilization, no cattle grazing. At least one use per year (until 15.11)	None	350 €/ha
B40	At least one cut per year (until 15.11)	Presence of at least 4 indicator species out of a list of 34	250 €/ha
B41	Ban of mowing until 01.07 at least one cut per year (until 15.11)	None	250 €/ha
B42	Maintenance of year-round old grass strips/areas on 5 to 20% of the area.	None	50 €//ha

3.2. Economic framework and empirical modelling

Our analytical framework follows a three step approach. In the first stage, we estimated the probability of a farmer adopting the scheme as a function of the contract attributes and the ecological status of farms. We observed how these features influenced the willingness to accept (WTA) the contracts. In a second stage, we tested if preferences vary among groups of participants using a latent class model. Finally, we modelled the determinants of the land allocation decision for the farmers who decided to participate in the schemes.

To estimate how the probability of a farmer selecting a certain contract varies by changing the attributes of the contract, we refer to the theoretical background for discrete choice experiments offered by the Characteristics Values Theory (CTV) (Lancaster 1966) and the Random Utility Theory (RUT) (McFadden 1973). While the CTV assumes that alternative actions are taken for the benefits associated with the chosen alternative, the RUT assumes that respondents facing different choices aim to maximize their utility. When it comes to enrol land in a contract, farmers have to choose among alternative land uses (or management practices) bringing different utility. In choice situation *t* (t=1, …, T), farmer *n* (n=1, …, N) will select alternative *i* (i=1,…, J) only if $U_{it} > U_{jt}, j \neq i$. The utility provided by each of the alternatives cannot be directly measured (Hensher et al. 2015), but it can be defined as the sum of a systematic (deterministic) component, reflecting observed characteristics of the contract and farmer, and a random or stochastic component ε_{ij}, representing unobserved decision-relevant elements:

$$U_{nit} = \beta X_{nit} + \varepsilon_{nit} \tag{1}$$

where X_{nit} is the vector of attributes of the contract *i*, chosen by farmer *n* on the *t*h choice card; while β is the vector of the parameter of interest, reflecting the average preference weight of each contract characteristic or attribute in the farmer's utility function. If we assume homogeneous preferences and independence of irrelevant alternatives (IIA), then the probability that the farmer *n* chooses alternative *i* in choice task *t* follows a conditional logit form (CL):

$$P(choice_{nt} = i) = \frac{\exp(\beta' X_{nit})}{\Sigma_{j=1}^{J} \exp(\beta' X_{njt})} \tag{2}$$

However, different contract designs affect different farmers in different ways, thus in reality this assumption does not hold. This latter can be tested with a Hausmann test (Hausman and McFadden 1984). To account for heterogeneity in tastes and scales, it is possible to use the mixed logit (Train 2009) and latent class approach (Boxall and Adamowicz 2002).

The mixed logit model allows individual parameters variation across farmers, assuming a continuous and random distribution of tastes (Train 2009). As a result, the probability that farmer *n* chooses alternative *I* in the *th* choice is defined by the following equation:

$$P(choice_{nt} = i|\beta_n) = \frac{\exp\left({\beta'}_n x_{nit}\right)}{\Sigma_{j=1}^{J} \exp({\beta_n}' x_{njt})} \tag{3}$$

We estimated two mixed logit specifications, one including all attributes plus the alternative specific constants (ASC), and the other including farm biodiversity as interaction term. The latter allows to account for the effect of farm ecological conditions on the probability of selecting a specific approach. The coefficient associated with the cost attribute was set as constant, while the other parameters were assumed to be normally distributed (Hensher and Greene 2003). The estimates of parameters from the first model were then used to assess farmers' marginal willingness to accept (MWTA) for different attributes (Boxall et al. 1996) using:

$$MWTA_X = -\frac{\beta_X}{\beta_{pay}} \tag{4}$$

Where β_X and β_{pay} are the parameters associated with attribute *x* and the monetary attribute *pay*, respectively. Confidence intervals are estimated using bias-corrected bootstrapping (Hole, 2007).

An important issue to consider when assessing the results of an experiment is the existence of heterogeneous effects (Curzi et al. 2022). Since previous studies have detected heterogeneity in farmers' willingness to uptake sustainability measures (Aslam et al. 2017; Niskanen et al. 2021; Hannus et al. 2020), we tested if preferences vary among groups of participants using a latent class model (Boxall and Adamowicz, 2002). The model allows to verify whether there are different segments in farm population having homogeneous different utilities. We used individual farm characteristics as membership variables: full or part-time farming, participation in AECS, specialization in dairy farming and number of milk cows. We chose these variables based on the hypothesis that farm structural information can help predicting farmers' choices and willingness to uptake risk (Niskanen et al. 2021). To identify the optimal number of classes, we used those with the lowest Bayesian Information Criterion (BIC) (Boxall and Adamowicz, 2002).

Since, in real world, farmers choose not only whether to participate in the contract, but also the amount of land to enrol (Latacz-Lohmann and Breustedt 2019), we also analyzed farmers' land allocation decisions following Kuhfuss et al. (2016). For each contract chosen, the farmer was asked to indicate the extent of his participation in hectares $y_{nit} \geq 0$. The amount of land to enroll is expected to depend on Z_{nit}, a vector of the proposed management prescriptions and individual farm(er) characteristics, and some unobservable factors u_{nit},

$$y_{nit} = Z_{nit}\,\alpha + u_{nit} \tag{5}$$

Since the land allocation information is only available for the contract alternatives selected in the first decision, there is a risk of selection bias in estimating the parameters of equation 5 through a simple OLS regression. The unobserved factors affecting a farmer's choice of contract, ε_{nit} in equation 1, are likely to be correlated with the unobserved factors that influence the area of land enrolled. To deal with this bias the two step procedure, similar to Heckmans' (Heckman 1979), proposed by (Bourguignon et al. 2007) was applied. In a first stage, the output of the mixed logit model is used to predict the probabilities of choosing each contract alternative. In a second stage the terms that are functions of the predicted probabilities of choosing each alternative are included in the land allocation OLS regression to control for selection bias. In this way, unbiased estimates of parameters α in the acreage equation (equation 5) can be obtained. For identity reasons, at least one of the variables included in X_{nit} cannot be included in W_{nit}.

3.3. Construction of the choice sets

For the selection of attributes, we used the *Q-methodology* (henceforth *Q-method*) (Watts and Stenner 2005). The method has been already used by previous studies to select relevant attributes (Venus and Sauer 2022; Armatas et al. 2014; Jensen 2019) as it provides structured, transparent and statistically-rigorous information in a context were stakeholders are confronted with conflicting decisions over resource management (Armatas et al. 2014; Venus et al. 2021; Venus et al. 2020). In the *Q-method*, a number of stakeholders (*P-set*) are asked to list a set of opinion statements (*Q-set*) based on their level of (dis)agreement with each statement. The sorting corresponds to a numerical ranking, which is then analyzed with principal component analysis to identify patterns across individuals (Previte et al. 2007). For each component (group of stakeholders) a relative ranking is obtained. The analysis of these rankings is informed by follow-up interviews with the stakeholders.

Our P-set was composed of 12 stakeholders working in the agri-environmental sector, who were asked to rank 22 statements on the desirable features of a grassland conservation scheme[1]. The analysis yielded three different priorities ("more funding for farmers", "technical support and flexibility for farmers" and "environmental protection") as well as several points of agreement or disagreement (Table A2 in the Appendix), which accounted for 61% of total variation. The most controversial statements were related to results versus action approaches, piloting the schemes, monitoring responsibilities, ecological thresholds, and contract flexibility. The legitimacy of a collective bonus, previously explored by (Šumrada et al. 2022; Kuhfuss et al. 2016) was excluded by all stakeholders.

The information was used for developing the five attributes in our experiment, namely: practice, baseline payment, ecological result, ecological payment and monitoring (Table 2Table 2). Our selection of levels was informed by the qualitative responses in the *Q-method* as well as the literature. We referred to the existing premia by the Cultural Landscape Programme (StMELF 2022a) to make the scenarios as realistic and credible as possible for farmers. The specific farming practices and ecological results were included respectively as either the input and output metric triggering the payment. The farmer was thus offered a measure requiring either the implementation of a pre-established practice (late mowing or maximum livestock units - LSU) or the achievement of a certain ecological result (presence of a certain number of indicator species in their plots). The baseline payment and the ecological payment represent the premia

[1] For additional information about the Q-set and Q-results, please refer to contact the authors.

for the input and the outputs respectively. Some alternatives were also offering a combination of both approaches. In such a way the farmer was confronted to result-based (RBS), action-based (ABS) and hybrid-based (HBS) measures (an example of choice cards is in Appendix A1). We did not use explicitly a labelled design to avoid the label to influence choices (Fimereli and Mourato 2013), but we coded each scenario to enrich our analysis. The monitoring attribute refers instead to whom is in charge for monitoring the results: the farmer, who has the obligation to record and report the information to the authority every year, or the authority, who visits the fields on a yearly basis.

We used the software Ngene (ChoiceMetrics, version 1.2) to generate an efficient design that minimizes the standard errors of the estimated parameters. The design consisted of 24 choice cards divided in four blocks of six. Each respondent was randomly assigned to one block. Following Bliemer and Collins (2016), we used information on the direction of parameter estimates from Šumrada et al. (2022) and Latacz-Lohmann and Breustedt (2019) as priors. The final design has a D-efficiency of 99% (d-error 0.0039) and an A-efficiency of 90% (a-error 0.1079). The closer the D-efficiency is to 100% the better is the design, and the design with the lowest a-error is the A-optimal design (Choice metrics 2018).

Table 2. Attributes and levels in the choice experiment

Contract attributes	Attributes levels	Description
Practice	Late mowing (1.07) Maximum LSU (1.4 LSU) None	Dummy
Baseline payment (€/ha)	0€, 100€, 200€, 250€	Quantitative
Ecological result	0, 2, 4 or 6 indicator species	Quantitative
Ecological payment(€/ha)	0€, 100€, 200€, 300€	Quantitative
Monitoring	Farmer Authority	Dummy

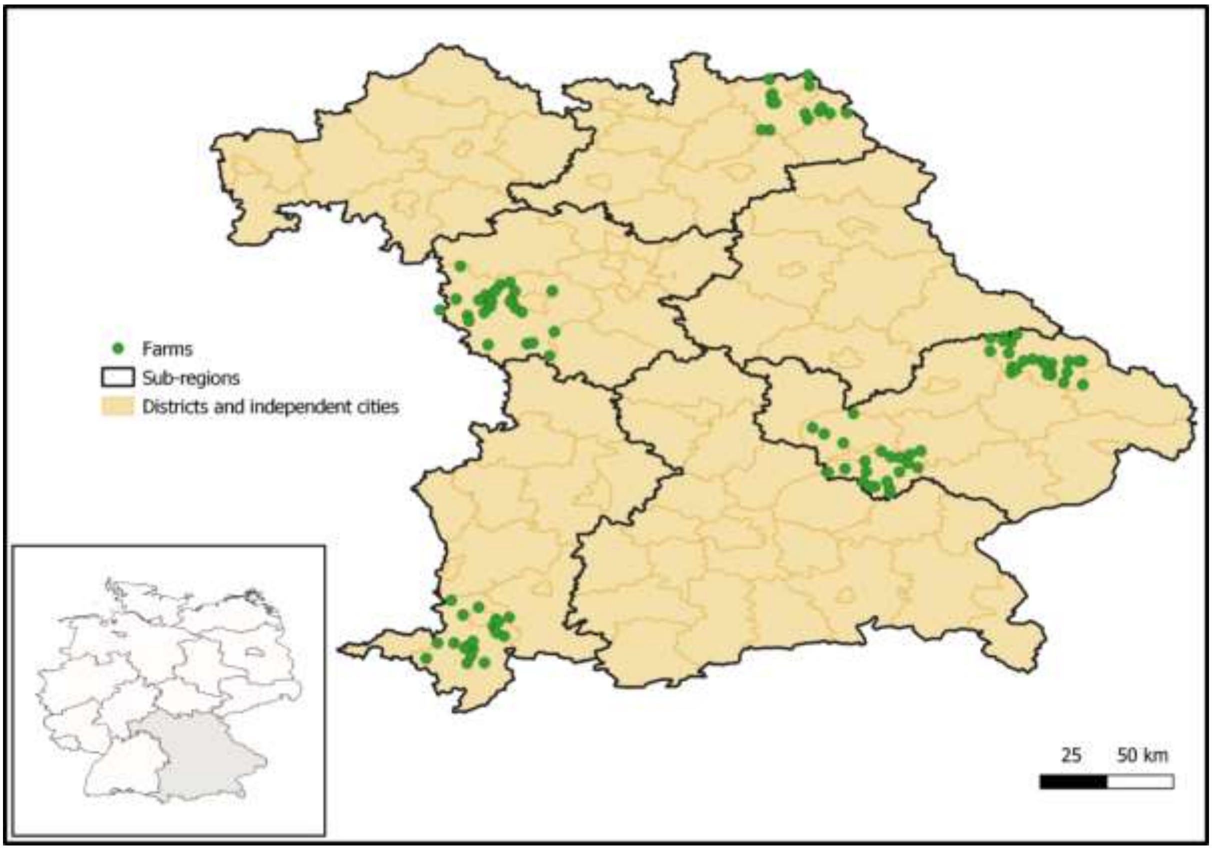
3.4. Survey approach and data collection

Data were collected in-person in June-July 2022. A total of 107 farms were visited, and the full sample participated in the survey. The sample was drawn to be as representative as possible of farms having the characteristics for participating in grassland extensification schemes. In our sampling strategy, we followed a stratification criteria, where we first targeted five districts[2] Figure 1 reflecting the variety of agro-ecological regions and farming conditions in Bavaria

[2] Districts are: Ansbach Hof, Landshut, Oberallgäu and Regen.

(StMELF 2022b). As a second step, we stratified the farm population with more that 0.2 ha of grassland[3] according to structural characteristics such as amount of utilized agricultural area (UAA), share of grassland area and previous participation in AECS. The farms matching our selection criteria were contacted and invited to voluntarily participate in the survey[4]. Each farm was visited by two enumerators, one in charge of conducting the DCE, and the other of collecting the ecological data, as described in next section. After the collection of socio-economic data, each respondent was introduced to the type of choice task required. The task started with a cheap talk (Appendix A1), and after the description of the attributes, the respondents were confronted with the choice between two alternative contracts and an opt-out option (none of them). The farmers were then asked to indicate the amount of land they would have enrolled in the chosen measure.

Figure 1. Farms' location



[3] 0.2. ha of enrolled land is the minimum requirement to participate in KULAP.

[4] Farmers' contacts were facilitated by the Bavarian State Ministry for Food, Agriculture and Forestry (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten – StMELF). Farmers were offered a voucher as a form of gratitude for their participation.

3.5. Ecological approach and index

The method for the biodiversity data collection was built on Herzog et al. (2012) and Heinz et al. (2013). The objective was to obtain a scientifically sound index for farms' ability to provide grassland biodiversity in terms of plant species richness (Herzog et al. 2012; Birrer et al. 2014). The method did not have the ambition of measuring the overall farm ecological situation. To obtain the index, the list of indicator plant species developed by the Bavarian State Institute for Agriculture for the B40 scheme (LfL 2014) was used. The list, defined by Heinz et al. (2013), comprises for meadows and pastures 34 flower species (or group of species) of all nature regions of Bavaria. Due to their close correlation with the total number of species these are considered to be a good indicator of its overall plant biodiversity (Ruff et al. 2013). For site selection, we used the method proposed by Herzog et al. (2012) of observing one plot for each land use type. We thus looked at four categories of grassland uses (meadows and (mowen) pastures - intensively and extensively used) and collected one observation for each land-use type (Russi et al. 2016). For each plot, the vegetation was sampled on a 2 m wide and 100 m long transect along the longest possible diagonal of the investigation area following the method by LfL (2014). All observed species from the 34 species list were registered. The information was then used to estimate the weighted average number of indicator species present at the farm level. Weighting allowed to take into account the variation of ecological value among different farm sites based on intensity levels. More formally, the environmental index for each farm i can be described by:

$$Environmental\ Index_i = \frac{\Sigma_{j=1}^{4}\ n_{ij} * area_{ij}}{grassland\ area_i} \qquad (6)$$

whereby n is the estimate of the number of present indicator species for each grassland use type j (intensive meadow, extensive meadow, intensive pasture, extensive pasture). The variable $area$ represents the area of each grassland use type j and $grassland\ area$ is the value of total grassland area per farm i.

4. Results

4.1. Sample overview

We compared our sample with the Bavarian farm population (Table 3). The similarities in the socio-demographic and structural characteristics of farmers and farms (such as age, presence of a successor, agri-environmental-climate scheme participation, and share of rented land) suggest a good level of representativeness. Due to the chosen sample strategy, compared to the Bavarian average, our sample has a higher representation of dairy farms (69%) and farms with a greater share of grasslands (57.3%). The average farm size is larger (68.02 ha) than the regional average, which is due to the lower participation rate of part-time farmers (usually small farms). In our sample, the share of full-time farmers is 73.8%, compared to the Bavaria average of 43.3%.

On the ecological side, we observed plant species diversity in 141 transects. Table 4 shows that most of the land area in our sample is meadow intensively used, with farmers performing in average 3-6 cuts per year depending on weather conditions. The rest of the permanent grassland is mainly used extensively, either as meadow or pasture. This share reflects the Bavarian figures on grassland use (StMELF 2022b; Kuhn et al. 2011). The number of indicator species found in the observed transects ranges from 0 to 13, with an average of 2.58 species per transect. Finally, the average biodiversity index is 1.74. Intuitively, this would mean that, on average, we find 1.74 indicator species in each hectare of farm land.

Table 3. Sample description and comparison with the regional population (n. obs = 107)

Variables		Sample[5]	Bavaria
Male (%)		86.9	-
Age by classes (%)	≤55years	54.2	55.9[a]
	≥55years	45.8	44.1[a]
Successor (%)		50,5	43.6[a]
Agricultural education (%)		85.9 (34.7)	63.0[b]
Experience (years)		22.4 (13.6)	-
Average farm size (ha)		68.02 (64.7)	30,7[b]
Farm size by classes (%)	<10 ha	3.8	36.8[b]
	10-19.9 ha	8.4	21.1[b]
	20-49.9 ha	29.0	23.1[b]
	50-99.9 ha	35.5	13.5[b]
	100-199.9 ha	23.3	5.5[b]
Average arable area (ha)		39.4 (32.8)	28.57[b]
Average grassland area (ha)		36.9 (55.07)	13.33[b]
Share of grassland		57.3 (31.7)	34.1[b]
Share of rented land		46.1 (23.5)	51.0[b]
Full-time farms (%)		73.8	43.3[b]
Organic farms (%)		22.5	12.1[b]
Dairy farms (%)		69	34[b]
Participation in AECS (%)		59.8	68.0[c]
Population		107	75 309[d]
	Ansbach	23	2 392[d]
	Hof	16	843[d]
	Landshut	21	1 743[d]
	Oberallgäu	18	2 059[d]
	Regen	22	925[d]

Sources:
[a] Destasis (2020) – Note: takes into account only individual companies.
[b] StMELF (2022b) – Note: refers to farms with milkcows farming.
[c] Destatis (2021) – Note: refers to all AECS payments, both for grassland and arable land.
[d] Destasis (2020) – Note: refers only to farms managing permanent grassland areas.

[5] Standard deviation in parenthesis.

Table 4. Descriptive statistics of observed transects in our sample

Variable	Defining criteria	Mean (SD)	Min-Max	Total
Intensively used meadow (ha)	>2 cuts	18.58 (19.29)	0-97.5	2182
Extensively used meadow (ha)	≤2 cuts	6.38 (11.95)	0-90	652
Intensively used (mowing) pasture (ha)	>2 cuts or >1.4 LSU	2.4 (6.67)	0-40	278
Extensively used (mowing) pasture (ha)	≤ 2 cuts or ≤1.4 LSU	6.26 (37.02)	0-425	826
N. of species		2.58 (2.54)	0-13	
Biodiversity index (BI)		1.74 (1.86)	0-10.28	
N. of transects			141	
N. of obs.			101	

4.2. Preferences analysis

We considered two versions of the model: first, a basic model including only the contract attributes (MXLI); second, an extended version investigating interactions with the biodiversity index (MXLII). The deterministic part of our utility function is represented by the five attributes included in our experiment (Table 5). We also introduced two alternative specific constants (ASC), which correspond to the result based (RBS) and the hybrid based (HBS) alternatives. To this end, we defined a binary variable, which took the value one if the alternative had a result (or hybrid) based approach, and zero otherwise. A positive and statistically significant coefficient for the two parameters indicates whether these approaches are preferred compared to the baseline situation. For identity reasons, we could not also include the opt-out option as an ASC in these models. However, we estimated a model with the opt-out option as ASC, and found this to be not statistically significant (Appendix A3). This confirms previous studies that found farmers not having a clear preference between entering the offered alternatives or to maintain the status quo (Šumrada et al. 2022). The results of the mixed logit models (MXL I) presented in Table 5 show that all coefficients of standard deviation are strongly significant, meaning that the model provides a significant better representation of the preferences than the CL model (Appendix A3). Also, in MXLI, the parameters of all independent variables are significant and match our expectations. While an increase in the payment increases probability of adoption, the inclusion of pre-established practices such as late mowing and maximum LSU consistently reduced the probability of uptake. Compared to maximum livestock, the requirement of late mowing makes the contract much less appealing. The negative coefficient of indicator species suggests that farmers' utility tends to decrease as this variable becomes larger. The positive coefficient of monitoring indicates that farmers do not consider being in charge of monitoring as a significant additional burden, and that they would prefer to conduct the monitoring by themselves compared to receiving an annual control from the authority. Additionally, the hybrid approach variable is significant while the result-based is insignificant. This suggests that if, on one side, farmers do not have a clear preference for result-based schemes, on the other, they would welcome an action-based including a top-up payment based on ecological results. After including the interaction of the ASCs with the biodiversity index in MXLII, we see that the direction and significance of coefficients remains unchanged and that the coefficient of RBS*BI is significant. The positive sign suggests that farmers with higher farm-level biodiversity are more likely to choose a result-based contract.

4.3. Marginal willingness to accept (MWTA)

Table 6 reports the estimated marginal willingness to accept (MWTA) of farmers for each attribute. That is to say, the relative effect of the single attributes on the necessary price premium to be paid to farmers. Estimated are based on the coefficients from MXLI, and reported only for parameters that are significant. The MWTA for late mowing is about 469 € while the one for maximum LSU is 242 €. The confidence intervals show that there is high heterogeneity among the farmers in their WTA estimates. The value for the provision of one indicator species is estimated in 97 €. This means, for instance, that for an outcome of four species as in the current B40 pilot scheme the scheme should pay 388 €. The MWTA of monitoring indicates that the farmer would in average be willing to forgo 106 € to do the monitoring on its own, and avoid a yearly inspection. Finally the MWTA values for HBS suggest that a farmer would be willing to forgo around 94 € for a hybrid based solution, approximately the price for one indicator species. As a robustness check, we asked farmers to directly state how much they would like to be paid for specific contractual arrangements. The average values are 517 € for late mowing and in 367 € for a four species result-based scheme. Results corroborate the validity of the MWTA estimates and suggest low bias in results (Lloyd-Smith and Adamowicz 2018).

Table 5. Estimated MWTA for attributes

Attributes	Mean (€/ha/year)	Confidence interval	
Late mowing	-469.25	-347.43	-681.30
Maximum LSU	-242.61	-123.75	-358.58
Indicator species	-97.02	-60.59	-160.44
Monitoring	106.83	209.63	38.35
HBS	94.82	362.05	54.25

Table 6. Results of the analysis of preferences using the mixed logit models.

Parameters	MXL I				MXL II			
	Mean		SD		Mean		SD	
	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Total payment	0.005***	0.001			0.005***	0.0009		
Late mowing (base: none)	-2.359***	0.399	1.197***	0.344	-2.242***	0.364	0.916**	0.311
Maximum LSU (base: none)	-1.220***	0.362	1.726***	0.284	-1.255***	0.343	1.684***	1.850
Indicator species	-0.487***	0.078	0.244***	0.059	-0.456***	0.076	0.238***	0.238
Monitoring (base: authority)	0.537***	0.174	0.734***	0.243	0.522***	0.163	-0.489*	-0.545
ASC: Result-based (RBS)[a]	0.476	0.399	1.012***	0.327	-0.027	0.433	1.024***	0.327
ASC: Hybrid-based (HBS)[a]	0.681*	0.402	1.372***	0.360	0.694*	0.416	0.657*	0.360
RBS*BI					0.215*	0.123	0.048	0.765
HBS*BI					0.048	0.119	0.016	0.929
Log likelihood	-576.628				-546.230			
Pseudo-R2								
AIC	1179.257				1126.461			
N. obs.	1926				1818			
N. farmers	107				101			

[a] The alternative specific constants were coded as the result based (RBS) and hybrid based (ABS) option respectively.
Note: *, **, *** represent significance level at 10, 5, and 1 percent, respectively.

4.4. Latent class model

For the latent class model, we identified two classes (Table 7) (BIC scores in Appendix A4). For Class I, the largest segment (67%), most attributes were significant. For farmers in Class I, the inclusion of pre-established practices such as late mowing and maximum livestock unit consistently reduces the probability of uptake. The payment has less influence on the participation decision compared to the acceptability of the imposed management practice. If farmers in Class I decide to uptake the scheme, they might be more interested in a hybrid-based solution compared to a pure action or result-based one. The negative coefficient of indicator species confirms that the farmer utility tends to decrease as the threshold required to trigger the payment becomes larger. However, this values is not as large as for farmers in Class II. The latter accounts for 33% of the respondents and seems to be largely motivated by the payment. Compared to Class I, farmers in Class II are more attracted by a contract limiting livestock density or paying for ecological results. According to the membership variables, full-time farming, specialization in dairy and non-participation in agri-environmental-climate schemes makes the farmer more likely to belong to Class I. These results suggest that more extensive types of farms (part-time, non-specialized and AECS participants) are more probable to show the preferences found in Class II.

Table 7. Results of the latent class model

	Class I		**Class II**	
	Coef.	**Std. Err.**	**Coef.**	**Std. Err.**
Total payment	0.0001	0.0009	0.008***	0.001
Late mowing (base: none)	-1.774***	0.349	-0.041	0.686
Maximum LSU (base: none)	-1.131***	0.338	1.623**	0.655
Indicator species	-0.234***	0.059	-0.334***	0.090
Monitoring (base: authority)	0.821***	0.171	-0.096	0.223
ASC: Result-based (RBS)	0.293	0.385	1.393**	0.679
ASC: Hybrid-based (HBS)	0.891**	0.370	-0.416	0.758
Class share	(0.67)		(0.33)	
Membership variables				
Full time	1.291*	0.728		
Participation AECS	-2.076**	0.894		
Dairy farms	1.646**	0.785		
Milk cows	-0.0009	0.008		
Constant	0.579	0.862		
Log-likelihood	-552.029			
N. obs.	1926			
Farmers	107			

4.5. Land allocation decision

Table 8 summarises the estimations on what drives the decision on the area to enroll. As explained in section 3.2., we estimated results using a two-step sample selection procedure building on MXLII. For identity issues, one of the variables could not be included in the land allocation equation. We used the attribute "maximum livestock unit (LSU)" as the instrumental variable in the selection equation. Our results show that the payment is highly significant and positive. This confirms previous findings that farmers allocate a greater portion of their farmland when the payment levels are higher (Tanaka et al. 2022; Latacz-Lohmann and Breustedt 2019). Late mowing is negative and significant, implying that farmers tend to allocate less land to a scheme that postpones mowing to July.

Table 8. Results of the analysis of land allocation decision

Dependent: % of grassland allocated	Coefficient	Std. error
Total payment	0.0008***	0.0002
Late mowing	-0.324***	0.053
Indicator species	-0.005	0.016
Monitoring	-0.151***	0.0417
Result-based (RBS)	-0.226**	0.092
Hybrid-based (HBS)	-0.031	0.082
Biodiversity index (BI)	0.046***	0.010
m1	-0.195***	0.076
m2	-0.254***	0.082
m3	-0.483***	0.175
Intercept	-1.269**	0.504
N. obs.	386	

Similarly, farmers seem to enrol less grassland if the scheme is result-based while, as expected, they would allocate a greater portion of their grassland if biodiversity levels are higher. Finally the coefficient for monitoring is significant and negative. This highlights that, despite farmers' would prefer to do their own monitoring, self-monitoring obligations reduce the amount of land the farmers' would be willing to allocate to the scheme. Surprisingly, the coefficient of the indicator species was not found to be significant. This result confirms Tanaka's et al. (2022) findings and suggests that, once taken the participation decision, the ecological threshold is not a key factor influencing farmers' land allocation. The three correction parameters introduced to control for selection bias (m1, m2, m3) are significant, suggesting that selection bias is relevant to the data.

5. Discussion

Payment for ecosystem services schemes are an essential policy tool to foster agro-ecosystems' sustainability worldwide. The theoretical literature suggests that results-based payments could be more cost-effective than action-based ones, while a hybrid of both could bring the same welfare gains without affecting farmers participation. Indeed, hybrid solutions might be more attractive to farmers than result-based options because they split the risk of non-achievement between regulators and farmers. While different studies have investigated farmers participation in result-based schemes, there is no evidence about how they valuate trade-offs between the three approaches and their preferences for hybrids. Also, no study has tried to understand how pre-existing farm ecological conditions relate to farmer preferences and can influence land allocation decisions.

In our analysis, we do not find a clear preference toward one or the other approach, which suggests that the payment mechanism is not the primary driver of farmer decision-making. Instead, the applicability of the prescribed management practice to the farming system (or the achievability of the outcome) seems to be more relevant for the uptake decision. As expected, participation rates decrease when pre-established management practices are imposed (Latacz-Lohmann and Breustedt 2019) or when payments are conditioned to higher environmental objectives (Tanaka et al. 2022).

In general, traditional action-based schemes are less preferred by farmers. Practices limiting farming choices that cannot flexibly adapt to local conditions significantly lower farmers' participation. In the case of grassland extensification, a late mowing ban, which does not adjust to yearly weather fluctuations, is firmly rejected for fear of losing the nutritional value of grasses. Thus, higher payments do not necessarily lead to higher uptake. The analysis of heterogeneity in preferences confirms these results. Farmers with higher opportunity costs linked to their farms' economic structure (e.g. specialized in dairy or intensive farming) are driven mainly by management prescriptions, not by payments. The flexibility offered by result-based contracts seems not a solution to them. This relates to the tradeoffs between ecological and economic production, and the high opportunity cost of taking risks for both the environmental and agricultural outputs. As expected, farmers' with higher opportunity costs of participation are more risk adverse. Our analysis shows that if farmers specialized in intensive farming accept to extensify their land management, they might prefer a hybrid solution, where a guaranteed basic premium is complemented by a top-up payment based on outcomes. In such a case, an appropriate combination would require a less stringent management practice (e.g.

flexible mowing date to adapt to regional climate differences and weather conditions) and a bonus for results balancing biodiversity conservation and grassland productivity.

In line with Šumrada et al. 2022, we found that farmers applying extensive farming are more willing to take the risk associated with a result-based approach. These farmers have lower opportunity costs of participation and are mainly driven by the payment. Thus, for uptake, premia must be high enough to compensate for the cost of achieving the outcomes and monitoring results. In line with previous studies, our findings suggest that farmers are willing to enrol in result-based schemes either when compensation is high enough to outweigh risks (Tanaka et al. 2022; Niskanen et al. 2021) or when alternative sources of income facilitate their pro-environment attitudes (Niskanen et al. 2021). Also, farmers are willing to uptake result-based schemes if risks of non-achievement are low, namely if they already manage their land extensively and meet the required ecological conditions. The analysis of land allocation decisions shows that the result-based payments affect negatively the amount of grassland enrolled. This suggests that farmers tend to commit to such contracts small parts of their farms. Often, these are extensively managed areas or areas out of production. These findings suggest a potential lack of additionality of result-based schemes in absence of baseline measures (Bartkowski et al. 2019).

In monetary terms, willingness to accept estimates show that farmers value their flexibility and that, compared to an action-based approach, the possibility to adapt farm management to local conditions is positively received. Risk aversion and uncertainty can explain the absence of a clear preference toward a result-based approach. In the case of result-based schemes, farmers are uncertain about their land being able to provide the ecological output, the time needed to obtain the first results, and the exact management practices leading to the outputs. If the knowledge gap about the provision of ecosystem services is not filled, farmers cannot estimate their cost for producing outcomes and cannot make biodiversity provision a more integral part of their farming. Similarly to Šumrada et al. (2022) and Moran et al. (2021), our findings suggest that specialized on-site technical advice is required to increase the uptake of result-based schemes. This support is required to help farmers identify plot that is worth dedicate to the production of biodiversity. In order to broaden scheme participation to a larger number of farmers, especially those with higher opportunity costs, a combination of technical advice with hybrid approaches is desirable.

6. Conclusions

In this study, we investigate farmers' preferences for alternative payment for ecosystem services schemes' approaches, contributing to the discussion on whether farmers should be paid for actions, results or both. To enrich our analysis and investigate possible additionality issues, we uniquely measure farm ecological performance with a biodiversity index to test whether farmers with greater biodiversity are more inclined to accept result-based schemes. We apply a discrete choice experiment to farmers managing permanent grassland in Bavaria (Germany), the majority of whom are active dairy farmers.

In our comparison of preferences for alternative contracts, we do not find clear predilection for any payment mechanism. Results reveal that neither the payment mechanism nor its amount is a primary driver of farmer decision-making. The applicability of the prescribed management practice to the farming system and the achievability of the outcome is key for the adoption decision. Indeed, farmers' perception about their capacity to meet the scheme requirements, for instance the presence of a certain number of indicators species, influences their choice to commit to the contract. If on the one hand, farmers are reluctant to implement management practices constricting their flexibility, more flexible result-based schemes do not always seem attractive. This is due to the tradeoffs between ecological and economic production in grassland extensification schemes and to the high uncertainty dominating the achievement of outputs in result-based approaches. Farm economic structure influences willingness to accept more risky contractual designs. Intensive farmers who accept to extensify their land use prefer hybrid-based solutions, compared to extensive farmers who prefer a result-based approach. Similarly, farms with greater levels of biodiversity tend to accept result-based schemes more frequently and are willing to enrol a greater share of their grassland. These findings confirm additionality concerns, suggesting low additionality of result-based payments. However, they also indicate that farmers' awareness of land's ecological potential plays a central role in fostering the uptake of result-based schemes.

Our findings have important implications for the design of agri-environmental schemes. They confirm the importance of targeting farmers and tailor payments based on scheme's primary objectives. For instance, some practices, such as postponing mowing dates, make dairy farming almost impossible, which might not always be desirable. If the scheme objective is to obtain a partial extensification of grassland use combined with agricultural productivity, hybrid solutions might be more effective for participation. Hybrid solutions can be effective in initial transition phases to allow farmers with higher developmental potential familiarize with provision of biodiversity. For increased uptake, the schemes need to offer on-site technical advice to help farmers assessing their plots' ecological potential. Pure result-based options, instead, might be more attractive to smaller subsistence farms, as compensation for maintaining their extensive management practices. In terms of additionality, setting baseline measures might be necessary for schemes aiming at modifying management practices. This might not be needed when the objective is to maintain extensification. In general, our findings reveal that current payments fall short of willingness to accept estimates. Thus, to increase participation, policy-makers should adjust existing premia to willingness to accept estimates.

We recommend that further research focuses on the impact of in-site technical advice, and hybrid schemes, as instruments to address perceived risks associated with the production of ecosystem services. Research is also needed to investigate how baseline assessments can be included in result-based contracts without affecting cost-effectiveness and participation.

The main limitation of this study is the relatively small-scale analysis. Because of the in-person farm visits and the plot-level biodiversity sampling, we could only focus on one region in Europe and a small sample size. Further analyses with larger samples are needed to confirm our results and further explore the heterogenous preferences for alternative designs. Of importance is to investigate how, compared to structural factors, behavioural factors, such as attitudes to risk, influence preferences. Moreover, it is unclear how our results might change based on different agri-environmental settings. Thus, additional research is needed to generalise our findings to other regions and ecosystem services. Future analyses could build upon our study by developing an improved environmental index capturing different dimensions of farm ecological performance. Also, it is worth investigating how climate change influences the perceived achievability of results and, thus, the willingness to accept different payment mechanisms.

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Appendices

A1. Scenario description and example of a choice card

The following scenario description was read to participants by the interviewers before beginning the choice experiment and after a cheap talk focusing on the importance of grassland biodiversity and the policy relevance of the experiment.

Suppose that the Bavarian State Ministry for Food, Agriculture, and Forest (BMELF) is presenting you the new set of measures for grassland conservation included in the Kulturlandschaftsprogramm (KULAP). In which one would you enroll your land, and how many hectares would you enroll under each measure?

Now, I will show you 6 cards. On each card, you will see two contract options (Measure 1 and Measure 2) and the possibility not to sign any contract (none). Each measure has a different combination of the following characteristics:

PRE-DEFINED SUSTAINABLE PRACTICE	The contract might ask you to implement specific grassland management practices, for example: • Late mowing day: you cannot mow before the 01.07 each year. • Maximum grazing: you can have more thatn 1.4. LU per ha of forage area. • No pre-defined practice
BASELINE PAYMENT	For each hectare you enrol in the contract, you will receive a payment ranging from 100E to 250E.
ECOLOGICAL OUTCOME	The contract might ask you to demonstrate the presence of a specific amount of biodiversity in your fields (it could be 0, 2, 4 or 6 indicator species from a predetermined list of plant species). In this case, you will be paid for the species richness in your grassland. The species are common flowering species found in extensively used grasslands (reference to exisitng LfL list was made) .
ECOLOGICAL PAYMENT	For the achievement of the ecological results, you will receive a payment ranging from 100E to 300E.
MONITORING	The compliance might be alternatively checked by the local authority, which comes every year for a field inspection, or by you. If you do the monitoring, you will be asked to fill out information sheets about the number of species you find or about the management practices you put in place, and to transmit them to the authority. In this latter case, the field inspection might be random, only if the authority considers there is a risk of non-compliance.

Please take all the time, and remember it is important that your choices really reflect what would be your real-life choices.

ID. Block.Card.	Measure 1	Measure 2	None
What are you rewarded for?			
Pre-defined sustainable practice	Late mowing (01.07)	-	
Basic payment	100 €	-	
Ecological result	2 Species	4 Species	
Ecological payment	100 €	300 €	
Who does the monitoring of compliance?			
Monitoring	Farmer	Authority	
In which measure would you participate and how many hectares would you enroll?	❑ .... ha	❑ .... ha	❑

Figure A1.1. Example of choice card: result and action based measures (translated from German to English).

ID. Block.Card.	Measure 1	Measure 2	None
What are you rewarded for?			
Pre-defined sustainable practice		Late mowing (01.07)	
Basic payment		200 €	
Ecological result	6 Species	-	
Ecological payment	300 €	-	
Who does the monitoring of compliance?			
Monitoring	Authority	Farmer	
In which measure would you participate and how many hectares would you enroll?	❑ .... ha	❑ .... ha	❑

Figure A1.2. Example of choice card: result and action based measures (translated from German to English).

A2. Q-Method results

	Perspective 1	**Perspective 2**	**Perspective 3**
Description	More funding for farmers	Technical support and flexibility for farmers	Environmental protection
Eigenvalues	2.58	2.13	2.0
Percentage of explained variance	23.41	19.36	18.16
Number of significantly loading Q-sorts (people)	6	2	3
Main topics they agreed with	• Communication & visibility • Practice • Piloting	• Length • Piloting • Free consultation	• Environmental goals • Results • Personal consultation

A3. Results from conditional logit and mixed logit

	CONDITIONAL LOGIT		MXL			
	Mean		Mean		SD	
Mean parameters	Coeff.	S.E.	Coeff.	S.E.	Coeff.	S.E.
Total payment	0.003***	0.001	0.005***	0.001		
Late mowing (base: none)	-1.428***	0.181	-1.963***	0.291	0.768*	0. 446
Maximum LSU (base: none)	-0.536***	0.161	-0.969***	0.281	1.624***	0.260
Indicator species	-0.220***	0.032	-0.331***	0.053	0.197***	0.476
Monitoring (base: authority)	0.410***	0.110	0.571***	0.146	-0.545	0.335
ASC: None[a]	-0.025	0.210	-0.187	0.295	-1.280***	0.238
Log likelihood	-630.215		-576.511			
AIC	1272.431		1175.024			
N. Obs.	107		107			

[a] The alternative specific constant was coded as the opt-out option "I would not enroll in any of these AECS"
Note: *, **, *** represent significance level at 10, 5, and 1 per cent, respectively.

A4. BIC scores for selecting the number of classes

Classes	BIC
2	1248.289
3	1280.976
4	1346.235
5	1375.594