FARMERS' ACCEPTANCE OF RESULTS-BASED AGRI-ENVIRONMENTAL SCHEMES – INSIGHTS FROM A CASE STUDY IN NORTH RHINE-WESTPHALIA

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Summary

To overcome adoption barriers of EU agri-environmental schemes (AES) related to the organizational burden from complying with the schemes' inflexible land management prescriptions, the EU has introduced result-based AES. Farms receive compensation once a contracted environmental result is verified. However, desired large-scale adoption of these result-based schemes is threatened since participating farmers risk losing the premium if they cannot reach the environmental target. This study aims at investigating acceptance of a hypothetically result-based AES for arable farmers in North-Rhine Westphalia, Germany, and elicit the role of behavioral factors and a social nudge for acceptance. The hypothetical scheme targets at increasing biodiversity of pollinator and bird species by supporting weed-species richness in intensive arable production. We used a split-treatment design to investigate the influence of a social nudge on scheme participation and area enrolled in the scheme (intensity). We rely on a convenience sample of 63 farmers and find an average willingness to participate of about 60%. Results indicate no influence of the social nudge on participation and intensity. Cognitive factors determine the willingness to participate while social and dispositional factors determine the intensity decision. This study sheds light on farmers' decision-making and delivers a pilot-scheme for follow-up studies.

Keywords: result-based agri-environmental schemes, contingent valuation, social norms, social nudge, biodiversity conservation

1. Introduction

Biodiversity loss throughout the European Union (EU) continues to require adequate policy responses (PE'ER et al., 2020), and the focus on environmental objectives in the common agricultural policy (CAP) has increased (EUROPEAN COMMISSION, 2017). However, while policy makers and society discuss stricter rules and a shift towards more ecofriendly farming, European farmers protest against increased environmental production standards (ISENSON, 2019; CUTHBERTSON, 2019). This suggests that European agriculture could benefit from policies that aim to reduce ecological pressures while simultaneously reducing farmers' frustrations about stricter regulations under increasing competitive pressure from countries with lower environmental production standards and weak regulation.

In the EU, voluntary agri-environmental schemes (AES) are an important instrument to mitigate environmental pressures of intensified agriculture. Still, the current design and implementation of AES may impair the achievement of the EUs environmental targets: AES are structured in a process-based way, paying the farmer for fulfilling the scheme prerequisites regardless of the environmental outcome (BURTON and SCHWARZ, 2013). This top-down nature of AES has been criticized for leaving the link between the promoted management practices and the environmental objectives unclear to farmers (BURTON et al., 2008), which undermines mutual appreciation of environmental efforts and possibly adds to resistance of scheme adoption (KROM, 2017). Furthermore, nature conversation requires fundamental changes in human behavior and relying mainly on financial incentives for alternative land management practices may thus prove ineffective (REDDY et al., 2017; DÉSSART et al., 2019).

Result-based schemes address many of the disadvantages of management-based schemes (see e.g. HERZON et al., 2018) and are increasingly being implemented on a local scale (CULLEN et al., 2018). These schemes compensate farmers for achieving a pre-determined contracted result, e.g. a fixed amount of insect species, independent of how they achieve these goals (RUSSI et al., 2014). From a behavior change intervention perspective, the important feature of result-based AES is that they allow building social capital: farmers can make use of their context-specific knowledge and thereby feel appreciated (BURTON and SCHWARZ, 2013). A connection between social recognition and appreciation for farmers' environmental efforts and their participation in result-based AES has been identified (RUSSI et al., 2016). Also, other farmers' opinions and adoption of sustainable farming practices determine the decision to participate in a result-based AES (KUHFUSS et al., 2015; PETH et al., 2018; LE COENT et al., 2018; MCGURK et al., 2020). These results suggest that social norms play an important role for AES participation. It remains unclear, however, how this social dimension of biodiversity conservation can be used to encourage behavioral change (KIDD et al., 2019). For example, results from existing studies on the use of social nudges to increase participation in AES are limited to process-based schemes aimed at reducing pesticide use in vineyards (KUHFUSS et al., 2014; KUHFUSS et al., 2015) or at improving nitrate balances (PETH et al., 2018).

Despite these advantages, result based AES possess challenging features with unknown consequences for farmer acceptance: designing a result-based scheme relies on monitorable result indicators and the risk of failing below the predetermined environmental target is delegated to the producer. Thus, while the absence of a set of inflexible management prescriptions may foster scheme uptake as farmers gain flexibility (KLIMEK et al., 2008), the increased payment uncertainty may reduce acceptance. Several studies have investigated result indicators and farmer acceptance of result-based AES in grassland management (KAISER et al., 2010; MARTÍNEZ-GARCÍA et al., 2013; SCHROEDER et al., 2013; BIRGE and HERZON, 2019). However, to our knowledge, thus far no study exists that focuses on result-based schemes for arable land management. Likewise, the importance of participation intensity was considered in studies on AES-participation (LATACZ-LOHMANN and BREUSTEDT, 2019; KUHFUSS et al., 2015), but to our knowledge, this topic has never been considered in a study on result-based AES.

We address these gaps by assessing the willingness to participate in a hypothetical result-based scheme targeted at pollinator and bird conservation via an online contingent valuation survey. As weed species richness functions as important food and habitat source for insects and their predators (VAN ELSEN, 2000), the scheme promotes increasing weed species richness in arable farming. Our case study was conducted in the federal state of North-Rhine Westphalia (NRW), Germany. Here, biodiversity-enhancing measures in arable farming are applied only on 2.5% of the area registered under environmental schemes (LWK NRW, 2020). To measure possible influences of farmers' social environment on decision-making, we test whether a social nudge, in our case the information about other farmers' satisfaction with the result-based AES, will foster scheme participation and intensity (area willing to enroll). We frame this under hypothesis 1 (H1). Based on the classification by DÉSSART et al. (2019), we tested how other behavioral factors such as perceived environmental and financial benefits and risk tolerance relate to the participation decision; we frame this under hypothesis 2 (H2). Furthermore, the likelihood of participation in a sustainable farming practices has been found to vary with personal characteristics such as age (MA et al., 2012), gender and education level (MZOUGHI, 2011), production-related factors like farm size and share of area rented (MCGURK et al., 2020), and type of the farm branch e.g. specialization (WYNN et al., 2001). Therefore, we test the influence of personal and farm characteristics on scheme adoption and frame this under hypothesis 3 (H3). This study sheds light on farmers' decision-making and delivers a pilot-scheme for follow-up studies.

Section 2 presents the scheme development, the survey structure and the empirical approach. Section 3 presents results and section 4 the discussion and conclusion.

2. Materials and Methods

2.1 Developing the hypothetical result-based agri-environmental scheme

A major challenge when designing a result-based AES is the choice of the result indicator (HASUND, 2013; FLEURY et al., 2015). As the objective of our scheme is to foster weed species richness, we define indicator weed species as a result indicator. These indicator weed species are sensitive to specific management options, e.g. pesticide and fertilizer use (VAN ELSEN, 2000). Thus, an increase in these species can be obtained within one cropping season. Additionally, farmers can easily observe whether their practice is successful by monitoring the weed species on their enrolled area. We focus on regional weed species rather than red-list species to make the AES in the survey as realistic as possible. Three indicator weed species were identified: *Arabidopsis thaliana* (thale cress), *Centaurea cyanus* (cornflower) and *Papaver rhoeas* (common poppy).

To allow the farmer to obtain usual yields and to lower the adoption threshold for farmers, the approach of ULBER et al. (2011) was adopted: we only include dicotyledonous weeds as target species. Monocotyledonous weeds are allowed to be eliminated via chemical weed control. Based on previous research on result-based AES (MOXEY and WHITE, 2014; BIRGE and HERZON, 2019), we use a hybrid approach to choose indicators and payment criteria as we combine a process-based scheme with a result-based (top-up) scheme. The underlying idea is to reduce the risk for farmers such that they can be sure to get a payment as they obey the conditions of a process-oriented AES independent from the anticipated results of the result-based AES (HERZON et al., 2018).

In our hypothetical scheme the farmer is paid by 50 cm width between rows that are not sown and thereby allow the indicator species to grow. Payment is based on rows of 100 m length. The farmer is free in the choice of how many of these rows he would like to implement. From a technical point of view there is not much additional effort needed by the farmer as normally all sowing machines have the option to leave certain rows not sowed, for wheat a mean row width of 10 cm is assumed (KÖLLER and HENSEL, 2019). To provide a realistic scenario for the survey, participants have been informed that the chamber of agriculture NRW will monitor the existence of weeds at a certain point in the enrolled field by counting the rows left not sown. We set a funding period of two years as farmers prefer flexible time horizons (BURTON and SCHWARZ, 2013).

Considering similar existing schemes such as one within the framework of contractual nature conservation in NRW, where the farmer receives a payment for doubling the seed row distance in winter and summer cereals (LWK NRW, 2017) or the existing AES of flowering strips (LWK NRW, 2021) as well as contribution margins for soft wheat in the harvest period 2018/2019 in NRW (KTBL, 2020), opportunity costs (OC) may range between €5 and €7. As the premium should not only cover OC but also compensate for other costs such as transaction costs, this amount indicates the minimal compensation level. Our payment vector of the contingent valuation scenario starts at €6 and increases in two-euro-steps up to €20 per row and year. We specifically designed the payment vector to include comparatively large numbers and to avoid placing the amount that is equivalent to the opportunity costs in the middle of the payment ladder to enable unbiased welfare estimates (JOHNSTON et al., 2017). The relatively high payment level of €20 per row serves as a test for internal validity. A large proportion of high values would be consistent with a lack of incentive compatibility (CARSON and GROVES, 2007).

2.2 Sample and structure of survey

The online survey was conducted for four weeks (9th of April 2020–7th of May 2020). In the first week, advertisements were published in two weekly local agricultural magazines (LZ Rheinland, Landwirtschaftliches Wochenblatt) as well as online for a period of four weeks (top agrar online, LZ Rheinland online). Participants were offered the chance of winning one of three 50 € vouchers per 100 participants for a workwear brand, that is popular among German farmers. Farms had to be located in NRW and have a minimum size of 2 ha arable area (rented or owned) to be eligible for participation. Participants were assigned randomly to the treatment groups, treated (with nudge) and control (without nudge).

Table 1: Statements and aggregation to variables of behavioral factors

Statements	Behavioral factors	Cronbach's alpha
How do you consider the participation in the result-based scheme in terms of risks?	Perceived risks[1]	/
The premium will totally cover the additional costs of the new result-based AES.	Perceived control	0.50
The new result-based will be easy to implement on my farm.		
The new result-based AES will …	Perceived env. benefits	0.67
… make the field optically appealing for me.		
… contribute to foster biodiversity.		
… help to combat climate change.		
I expect that participation in the new AES would lead to the following results for my farm:	Perceived financ. benefits	0.51
Reduction of productivity		
More bureaucracy		
Less work		
Higher risk in yield		
Higher yields		
Higher profitability		
How do you rate your knowledge of the following production methods? My knowledge about …	Knowledge[2]	0.63
extended crop rotations (existing AES) is …		
flowering stripes (existing AES) is …		
integrated pest management is …		
conservation-oriented soil cultivation is…		
Most farmers in my district would participate in the new agri-environmental scheme (AES).	Descriptive norm	/
People, whose opinion is important to me, would support my participation in the new AES.	Injunctive norm	0.65
My professional colleagues think I should conduct the new AES.		
It is important to satisfy the expectations of walkers on the appearance of the landscape.	Signaling	0.67
It is important to be perceived by other farmers as environmentally friendly.		
It is important to show the public the commitment to the environment.		
I would like to use a sign on the field to inform about the conducted AES.		
Do you consider yourself as risk averse or risk seeking?	Risk tolerance[3]	/
The use of chemical inputs has a negative impact on humans' and animals' health.	Environmental concern	0.84
Environmental problems that result from agricultural activities are exaggerated by the media.		
Organic agriculture is better for the environment than conventional agriculture.		
The use of pesticides is acceptable, if then high yields are obtained.		
Organic agriculture is a temporary phenomenon.		
Chemical inputs have no negative impacts, they foster production of high-quality yields.		

[1]1 if not risky, 5 if risky, 2, 3, 4 if in between, 0 = I don't know; [2]Likert-scale for knowledge questions: 1 = very poor, 2 = poor, 3 = average, 4 = good, 5 = very good, 0 = I don't know; [3]1 if not risk seeking, 5 if risk seeking, 2, 3, 4 if in between, 0 = I don't know

After few introductory questions concerning AES in general (e.g. former scheme implementation), the participants were presented the CV scheme: first an introduction to the result-based approach and then the hypothetical result-based AES was presented. To the presentation of the scheme we added the social information treatment for the treated group: "Imagine two farmers in your county told you, that they're very satisfied with this scheme." After having seen the scheme, participants had to decide if they can imagine to participate and if so, how much land they would be willing to enroll. Additionally, more concrete scheme attributes had to be stated (minimum premium, preferred row width and number of rows unsown). To reduce hypothetical bias (LOOMIS, 2011), we introduced a cheap-talk script. This script directly mentioned that the hypothetical nature of the scenario may lead to overestimation of one's willingness to participate and reminded participants to answer honestly and realistically.

After the CV scenario, participants were asked to evaluate statements concerning different behavioral factors. The behavioral factors were selected based on DÉSSART et al. (2019) who categorized all factors into three groups (dispositional factors, social factors and cognitive factors) and sorted them according to their distance to the decision. Overall, we considered ten behavioral factors in the survey and asked for them in 30 different statements on a 5-point Likert-scale (1 = I strongly disagree, 2 = I disagree, 3 = I neither agree nor disagree, 4 = I agree, 5 = I strongly agree, 0 = I don't know) which were derived from the literature (Table 1). We aggregated the statements and checked for the reliability of these aggregated Likert-scales via Cronbach's alpha (α) (CRONBACH, 1950). All scales exhibit good to high reliability ($\alpha > 0.5$).

A total of 564 people clicked on the link to the survey and 110 finished the survey. After the data cleansing process where we excluded observations containing (systematic) missing values 63 observations remained for the statistical analysis. Our sample can be seen as a convenience sample, which is useful in studies with pilot character as the present one (TEDDLIE and YU, 2007).

2.3 Empirical approach

We model the participation decision and intensity using a two-step Heckman sample selection model following GIOVANOPOULOU et al. (2011) and ZIMMERMANN and BRITZ (2016). In the first step, the probability of participation in the AES scheme is modelled. In the second stage, the intensity of participation, measured as share of area willing to enroll on total arable area belonging to the farm, is modelled conditional on the selection equation of stage 1. All estimations were carried out using the R package sampleSelection.

We denote farmer *i's* indication to participate by D_i as outcome of a utility maximization problem that can be described as a function of X_i(farm and farmer characteristics and behavioral factors as in Table 2). To model the participation probability, we follow a probit specification and a farmer's probability to participate is given by:

(1) $\Pr(D_i = 1|X_i) = \Phi(X_i\beta) + \varepsilon_i \quad \forall\, i = 1, \ldots N$

Wherein β denotes a vector of coefficients to be estimated associated with variables in X_i(summarized in Table 2) and ε_i is the error term. We estimate the probit model in (1) using maximum likelihood.

For the second stage, intensity is modelled in a linear fashion. That is, using linear regression, we model intensity of participation in terms of acreage indicated by the farmers to be enrolled in the AES as a function of farm and farmer characteristics and behavioral factors (see Table 2 for details) summarized in (Z_i). One major implication of the Heckman selection model is the exclusion restriction, e.g. a variable that affects the participation but not the intensity decision (WOOLDRIDGE, 2013). The variable of *perceived control* was found to be a driver for the participation decision but not for the intensity decision (i.e. it is part of X_i but not of Z_i) based on statistical significance in the Wilcoxon Rank-Sum test ($p < 0.01$). Thus, we exclude it from the second stage (i.e. it is not a part of Z_i). By implementing the exclusion restriction, we can mitigate problems from multicollinearity between the explanatory variables and the Mills ratio.

The data indicating the intensity of AES-participation only comes from farmers that can imagine participation in the first stage, which can cause self-selection bias if factors that influence the intensity of AES-participation simultaneously influence the participation decision. Heckman's self-selection specification (HECKMAN, 1974) assumes that the error terms of the participation and of the intensity of participation equations are correlated and that the (stated) participation in the result-based AES dominates the intensity of participation decision. Domination implies that zero participation is the result of the AES-participation decision and not of the intensity of AES-participation decision. Hence, to fulfill the second-stage regression conditions on the probability of participation we add the inverse Mill's ratio from the first step as additional regressor:

$$(2) \qquad y_i^* = \gamma Z_i + \sigma \left[\frac{\phi\left(\frac{\beta X_i}{\sigma}\right)}{\Phi\left(\frac{\beta X_i}{\sigma}\right)}\right] + \upsilon_i \text{ , } \forall\, i = 1, \dots N$$

where $y_i = y_i^*$, if $y_i^* > 0$, γ is the vector to be estimated, υ_i is the unobservable error term. Equation (2) is estimated via ordinary least squares (OLS) (CAMERON and TRIVEDI, 2005: p.548).

Table 2: Descriptive results of farm and farmer characteristics and behavioral factors

Statistic	Mean	St. Dev.	Min	Max
Farm and farmer characteristics				
Arable area	54.3	45.2	2.0	200
Area rented	28.0	31.1	0.0	155
Farm type (base category: arable farm)[1]				
Mixed farm (grassland+livestock)	0.6	/	0.0	2.0
Other types and special crops	0.1	/	0.0	2.0
Production method (base category: conventional) [1]				
Organic	0.1	/	0.0	1.0
Position on farm (base category: farm leader) [1]				
Non-farm leader	0.4	/	0.0	1.0
Age	43.3	13.8	19.0	71.0
Gender (base category male) [1]				
Female	0.1	/	0.0	1.0
Education (base category non-academic) [1]				
Academic	0.4	/	0.0	1.0
Cognitive factors				
Perceived control	2.7	1.1	0.0	5.0
Perceived environmental benefits	3.0	1.1	0.7	5.0
Perceived financial benefits	1.9	0.6	0.7	3.0
Knowledge	3.7	0.7	2.0	5.0
Perceived risks	2.8	1.2	0.0	5.0
Social factors				
Descriptive norms	2.2	1.2	0.0	5.0
Injunctive norms	2.8	1.2	0.0	5.0
Signaling	3.5	0.8	1.3	5.0
Dispositional factors				
Risk tolerance	2.9	1.0	0.0	5.0

[1]mean for dummy variables given in share of the whole sample

To test our hypotheses, we apply the Heckman selection model with independent variables as summarized in Table 2. The Heckman selection model was run with 59 observations of which 26 can imagine participation in the result based-scheme (actually observed) and 23 do not (censored). We excluded the variables *prior scheme knowledge/ implementation*, *environmental* *concern* and *farm as main source of income* for convergence. For the second step, the linear regression on the intensity of participation, the log of the area willing to enroll as share of the whole arable area was taken. The variable of *perceived control* was left out in the second step as exclusion restriction.

3. Results

As 47 observations could not be considered for the final analysis due to missing data, the size of the groups was reduced randomly and thereby unequally. After data cleansing, the treated group contains of 26 observations and the control group of 37 observations. Table 3 gives an overview of the descriptive results and the farming population of NRW. Farms in our sample are larger in terms of arable area (56 ha vs 42 ha) and the share of area rented is larger (49 % vs 37 %). The share of farmers that have implemented AES in the last funding period is substantially larger in our sample (67 % vs 33 %). The survey reached mainly farmers that are experienced and interested in the topic, younger and better educated than the average farmer in NRW. These differences have to be kept in mind when drawing conclusions on the target population.

Table 3: Descriptive results of the sample compared to farming population in NRW

Variable	whole sample (n = 63) mean	treated group (n = 26) mean	control group (n = 37) mean	farming population in NRW[a] mean
Age in years	43	41	44	53[b]
Share of female participants	8 %	20 %	0 %	18 %[c]
Arable land in ha	56	56	55	42
Share of rented land	49 %	47 %	49 %	37 %
Share of participants having implemented AES already	67 %	65 %	67 %	33 %[d]
Share of organic farms	6 %	4 %	8 %	6 %
Share of farms where farm income as main income	42 %	46 %	39 %	53 %[e]
Share of participants having a university degree	29 %	42 %	19 %	11 %

Notes: own presentation based on own calculations and own data, sources for the last column as indicated [a] Source for last column unless otherwise stated: Landwirtschaftskammer Nordrhein-Westfalen (Dezember 2017); [b] AgriDirect Deutschland GmbH (2013); [c] this number indicates the share of female full-time employees in NRW in 2016; [d] Ministerium für Umwelt, Landwirtschaft, Natur und Verbraucherschutz (2019); [e] share of farms led in principle occupation

The proposed results-based AES for arable farmers was accepted by 60% of the farmers in our sample. Farmers indicated a preferred premium between €13 and €14 per row and year. The median premium is €10 for both groups. This result supports the confidence in our scheme development as there is neither a tendency to the middle (then the median would be at €12 or €14) in the choice of the premium nor a disproportionately high choice of the highest premium. We conjecture that the scheme was well understood and answers were not exaggerated, which lends credibility to the results.

The results of both equations of the Heckman model as presented in equations (1) and (2) are shown in Table 4. According to the pseudo-R2 measure, the model seems in a satisfying range but results must be interpreted with care given the small sample and potential biases related to that.

Results indicate that the social nudge seems not relevant in explaining the participation and the intensity (according to the t-test in both steps). For the participation decision, from the group of cognitive factors, we find *perceived risks* to negatively influence the participation probability. For the decision of intensity, we find *injunctive norms* and *signaling* from the group of social factors, and *risk tolerance* from the group of dispositional factors as variables contributing to explaining outcome intensity. *Injunctive norms* positively relate to area enrolled, but *signaling* negatively. For example, an increase in one unit on the aggregate 5-point Likert-scale for the factor *injunctive norms* increases the expected share of area enrolled in the scheme by approximately 69%. An increase in risk tolerance by one unit on a 5-point Likert-scale decreases the expected share of area enrolled by approximately 54%.

Table 4: Results of the Heckman selection model

	Selection (participation)		Outcome (intensity)	
	Estimate	(SE)	Estimate	(SE)
With nudge	-7.79	(4.74)	0.14	(0.32)
Farm type (base=arable farm)				
Mixed farm (grassland+livestock)	1.32	(3.07)	-0.3	(0.59)
Other types and special crops	6.08	(4.16)	-0.31	(0.67)
Farm and farmer characteristics				
Arable area	0.02	(0.02)	-0.00	(0.00)
Share of arable area rented	-3.24	(3.10)	-1.69**	(0.71)
Non-farm leader *(base=farm leader)*	6.55*	(3.46)	-0.46	(0.53)
Organic *(base=conventional)*	-1.01	(3.61)	0.04	(0.50)
Female *(base=male)*	1.91	(3.32)	-0.07	(0.60)
Age	-0.07	(0.11)	-0.01	(0.02)
Academic *(base=non-academic)*	10.71	(6.47)	0.15	(0.36)
Cognitive factors				
Perceived control	1.34	(1.30)		
Perceived environmental benefits	5.05	(2.95)	0.26	(0.27)
Perceived financial benefits	5.44	(3.49)	-0.70	(0.45)
Perceived risks	-3.95*	(2.12)	0.09	(0.31)
Knowledge	1.52	(1.51)	-0.38	(0.26)
Social factors				
Injunctive norms	1.44	(1.00)	0.69***	(0.19)
Descriptive norms	-0.03	(0.66)	0.11	(0.17)
Signaling	2.12	(2.12)	-0.92**	(0.34)
Dispositional factors				
Risk tolerance	-0.09	(0.96)	-0.54**	(0.20)
Constant	-35.37*	(20.32)	3.854	(2.48)
rho	-0.31		-0.31	
Inverse Mills Ratio	-0.20	(0.60)	-0.20	(0.60)
(pseudo) R^2	0.7		0.52	
Observations	59		26	

Note: *p<0.1; **p<0.05; ***p<0.01 (t-test)

The Heckman selection model shows that for the first step, the decision of participation, the variable of the *position on the farm* is statistically significant ($p < 0.1$). This dummy variable indicates if the participant in the survey is the leader of the farm (= 0) or not, e.g. family member, employee or other (=1). It can be seen that those who are not the farm leader are more likely to participate in the result-based AES. For the second step, the decision of intensity, the *share of the arable area rented* (in % of total arable area belonging to the farm) is statistically significant ($p < 0.05$).

4. Discussion

The first aim of our study was to examine if the use of a social nudge could increase likelihood and intensity of participation in the result-based AES. For neither the likelihood to participate, nor the decision of how much area to enroll, the influence of the nudge is statistically significant (i.e. we reject our H1). Several studies find evidence for the impact of social nudges. For example KUHFUSS et al. (2015) used a social nudge in form of a collective bonus and found a significant and positive influence on participation in a pesticide-reducing scheme among French wine-growers. Similarly CHABÉ-FERRET et al. (2019) found that the use of a social-comparison nudge influences water usage among French farmers. One reason for the lack of effectiveness of the nudge in our study might be its positioning in the survey. It was decided to place the social-nudge treatment above the table which explains the scheme. Thus, one idea could be to place the sentence right in front of the participation decision or to repeat it.

Another reason for non-effectivity of the social nudge in our study might be the different context. While KUHFUSS et al. (2015) and CHABÉ-FERRET et al. (2019) examined topics close to personal health like pesticide use or immediate economic benefits like water use, participation in our proposed hypothetical agri-environmental scheme brings no direct and immediate benefit for the contractor. Additionally, the impacts on biodiversity beyond the indicator species is diffuse and distant in time. These factors make biodiversity conservation different from other pro-environmental behaviors (KIDD et al., 2019). It could be that decisions in the biological conservation context tend to be less susceptible to social norms and should be addressed at the cognitive level. Evidence so far is, however, inconclusive. For example, REDDY et al. (2020) find that an information treatment targeted at the environmental and economic benefits decreased participation in a soil health program. PETH et al. (2018) compared the effectiveness of two information nudges in the context of a nitrate-mitigation rule. One nudge targeted the social level (descriptive norm) and the other targeted the cognitive level (perceived environmental and health benefits) and the cognitive nudge was more effective.

Our second aim was to investigate the association between groups of behavioral factors according to the classification of DÉSSART et al. (2019) and the participation in our hypothetical scheme. For the participation decision, we find that the cognitive factor of *perceived risks* negatively affects the decision. This points to the potential barriers related to the necessity of financial security (LÄPPLE and KELLEY, 2013), to the risk of decreasing yields (MZOUGHI, 2011; CHÈZE et al., 2020) and to the importance of risk aversion in farmers‘ decision making in farming (TRUJILLO-BARRERA et al., 2016). For the intensity decision, i.e. how much land to enroll in the AES, we find that two social factors and one dispositional factor affect the amount of land enrolled. The positive sign for the factor *injunctive norm* indicates that the more a farmer believes that his social surroundings would approve of the AES, the more land he will be willing to enroll. Hence, although the nudge was not effective, it seems that farmers are influenced by their social network at least for the intensity decision. The results regarding the variable *signaling* suggest that farmers who put more importance on presenting their environmental commitment tend to enroll less land for the result-based AES. We assume that most farmers who are interested in signaling their environmental engagement already participate in other AES and therefore might not want to enroll more land in such schemes. Overall these findings support our H2 and the idea that cognitive factors close to the decision-making context seem to be more important than dispositional factors that are more distal (DÉSSART et al., 2019). However, *risk tolerance* is negatively related to the amount of land enrolled. This suggests, that once the participation threshold is overcome, the scheme could be perceived as a possibility for income stabilization, which indicates the importance of addressing the perceived risks to increase likelihood of participation.

Lastly, we find that the share of rented land negatively effects the amount of land enrolled. These findings are consistent with DEFRANCESCO et al. (2007) who found the same result for grassland conservation. One reason might be that farmers with higher shares of rented land are working under tighter land constraints and might be more focused on production (MCGURK et al., 2020). This could also indicate that farms may favor outcome-based AES for their own land, potentially to avoid conflicts with the owner. Despite that only few farm and farmer characteristics could be found with notable influence, we conjecture that these results are along with our H3, though with weak evidence.

Our study faces two main limitations: first our sample consists of younger and better educated farmers than the average in NRW. Also, we mostly reached farmers that are experienced and interested in AES. This might increase the likelihood of participation in our sample. The homogeneity in terms of previous experience and knowledge of AES might also have downgraded the importance of other farmers' opinions and thus the effectiveness of our social-information treatment. A second limitation is that due to the limited sample size we could only investigate one version of the social nudge. Future research should focus on how to increase access to the farming population (e.g. WEIGEL et al., 2020) in order to reach farmers with less experience or ex ante interest in biodiversity conservation via AES. Furthermore it will be interesting to investigate whether a behavioral intervention treatment aimed at the cognitive level is more effective than a social nudge or whether a social-information treatment that is imbedded in a stringent framing (e.g. KUSMANOFF et al., 2020) can be more effective.

Our study delivers a pilot result-based agricultural program tailored to intensive arable farming. We found high acceptance rates, but perceived risk might pose a barrier for adoption. For the context of biodiversity conversation in arable farming, we deliver first evidence on the possible effectiveness of a social-information treatment and the influence of a wide range of behavioral factors on scheme uptake. The conservation scheme can serve as starting point for actual scheme design as well as future studies on the possible impacts of behavioral intervention strategies.

5. Literature

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