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**Determinants of farmers' willingness to participate in subsidy
schemes for pesticide-free buffer zones -
a choice experiment study**

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Abstract

Danish farmers have been far less interested in agri-environmental subsidy schemes (AES) than anticipated. In order to examine how to improve the appeal of such schemes, a choice experiment was conducted concerning 444 Danish farmers' preferences for subsidy schemes for pesticide-free buffer zones. A random parameter logit framework was used to capture heterogeneity among farmers. Our results indicate that 1) the vast majority of farmers are willing to trade off the size of the subsidy for less restrictive scheme requirements and that 2) the amount of the subsidy they are willing to trade off varies with specific scheme requirements, suggesting which features are most important for successful policy design. Our results suggest that farmers value flexible contract terms higher than reduced administrative burdens. Finally, we suggest a practical approach to estimating a monetary value of farmers' reluctance to participate in AES. While the trade off's that farmers are willing to make between subsidy size and individual scheme requirements are case-specific, our results concerning increased use of farm advisors, farmers ability of valuing different types of flexibility, and our attempt to place a monetary value on farmers' reluctance to engage in regulatory subsidy schemes have a potentially broader application platform.

Keywords: Farmer; preferences; participation; agri-environmental schemes, choice experiments; voluntary agreements

1. Introduction

Denmark has a long tradition of regulating the use of pesticides in agricultural production through a broad array of policy instruments. These include pesticide taxes, voluntary measures such as subsidy schemes for pesticide-free production, general information campaigns, subsidised farm level advisory services and subsidised use of decision support systems for pesticide management. Hence, the goal of reducing pesticide use has been pursued using a mix of polluter-pays as well as beneficiary-pays instruments with very different effects on farmers' welfare. In particular, agri-environmental subsidy schemes (AES) have been widely offered to farmers – partly because the schemes are encouraged by the Rural Development Fund under the present EU Common Agricultural Policy (CAP). Subsidy schemes for pesticide-free buffer zones along streams and lakes have been offered to Danish farmers for more than a decade in order to protect the aquatic environment and to prevent leaching of pesticides to the ground water. Alas, with limited success. Results fell far short of the political objective of 25.000 ha of pesticide-free buffer zones under voluntary schemes as agreements were signed for only about 9.000 ha in 2006 (Christensen et al., 2007; Pedersen et al., 2007; Ramboell Management A/S, 2008). In general, across Europe there are several examples of limited uptake of AES among European farmers and there is an increasing interest in identifying factors that determine farmers' interest in AES (Espinosa-Goded et al., 2010).

The two-fold purpose of the present paper is to 1) identify the extent to which Danish farmers are willing to trade off payments for less restrictive scheme requirements and 2) quantify Danish farmers' preferences for specific scheme features. Inspired by the

methodological approach by Ruto and Garrod (2009), a choice experiment is used. Our experiment includes a measure that to our knowledge has not been tested before, namely the use of farm extension service as a means to reduce transaction costs. Also, we include a variety of flexibility provisions, which allow us to estimate their relative importance. In particular, we investigate farmers' valuation of contract length as well as having the option to be released from a contract before it expires. Furthermore, we suggest that using a choice experiment offers a straightforward and not exploited opportunity to estimate a monetary value of farmers' reluctance to participate in AES.

Pesticide-free buffer zones along hedgerows are used as case because recent studies have identified the usefulness of such buffer zones to protecting terrestrial biodiversity (Bruus et al., 2008; Navntoft et al., 2009). Currently, only buffer zones along streams and lakes are included in regulatory initiatives; thus our study on pesticide-free buffer zones along hedgerows might provide useful input to solving the ongoing problems of fulfilling the goals of Danish pesticide regulation, as well as serving as an input to reforming the CAP.

After a short review of the experiences with AES and potential arguments for their limited success, the case and the statistical method employed will be presented. Subsequently, the empirical analyses are presented and the results are discussed and concluded upon.

2. Explaining limited success of AES

Evaluations of the effectiveness of the pesticide plans (and AES in general) point to multiple explanations of why farmers have not signed up in the numbers predicted by ex ante policy analyses. One line of argumentation suggests that farming conditions have changed in a manner that has made AES less attractive. In particular, factors such as changed input/output prices, changed cropping structure, changed climate and more aggressive pest attacks have reduced the relative values of the economic incentives offered by the AES. As a consequence, policy instruments that were designed to provide adequate economic incentives under a given set of farming conditions could end up providing in-adequate economic incentives due to changes in those conditions. In the Danish case, these arguments may explain the sparse interest among farmers in signing up for subsidy schemes for pesticide-free production as the payments have not been sufficient to compensate farmers for their income loss. Similarly, it has been argued that insufficient effect of the Danish pesticide taxes was a consequence of the taxes being too low to induce a reduction in the pesticide use. Christensen et al., 2007; Economic Council, 2010; Pedersen et al., 2007). Also, the increased use of environmental cross compliance obligations has been argued to deter farmers from involving in AES¹.

A second line of argumentation pursued in the international literature concerns transaction costs. Falconer (2000) found that farmers' perceived costs of complying with restrictions in a voluntary agreement exceeded their perceived income losses and concluded that transactions costs serve as barriers for engaging in AES. This finding is

¹Cross compliance has been part of the common agricultural policy (CAP) since 2005 as a means to increase farmers' incentives to comply with regulations regarding the environment, health of animals, plants and humans, animal welfare, and good agricultural practice. Cross compliance links the direct payment scheme under the CAP with environmental regulation, as repeated or serious violations of the regulations in these areas will induce reductions in the direct payments (Ministry of Food, Agriculture and Fisheries, 2010).

supported by Mettepenningen et al. (2009), who estimated private transaction costs (which they defined as costs that are not related to changes in profits) for an average European farmer as 14 % of total AES-related costs, which was ‘considerably higher than indicated by previous research’. A particular motivation for research on private transaction costs is that AES payments under the CAP is allowed to exceed the costs of lost production by up to 20 % under the condition that the additional payments are used to cover documented transaction costs.

A third line of argumentation suggests that farmers do not only optimize in the manner assumed in standard economic models. Instead, their decisions are also shaped by other motives, such as professional pride in high yields with little regard for factor costs, as well as higher order objectives such as keeping up family traditions, maintaining good community relations and remaining independent (Burton et al.; 2008; Gasson, 1973; Mettepenningen et al., 2007; Nielsen, 2010). To the authors’ knowledge very little research has been done with respect to identifying the relative importance of such non-economic motives at the level of the individual farmer, how widespread various types of motives are across the population of farmers, and to what extent non-economic barriers can be overcome by offering higher economic incentives.

The present study contributes to the second and third lines of argumentation as we seek to identify farmers’ willingness to trade off subsidy payments with other scheme requirements but without going into details concerning what types of costs and what types of motives determine his specific trade off’s.

Several sociological studies have focused on identifying factors that affect farmers' propensity to participate in AES. These factors have been divided into categories such as farm characteristics (financial status, size, management practise, bio-geographical conditions of farm land, presence of a successor, etc.), farmer characteristics (economic motivation, age, education, attitudes, etc.) and contextual factors (social and cultural factors, level of information, etc.). Reviews on the importance of these factors are provided by Siebert et al. (2006) and DeFrancesco et al. (2008). Only recently, studies have emerged that focus on investigating the importance of contract specific factors. These will be discussed below.

In relation to scheme design, participation barriers can be addressed by turning two different types of handles. One solution is to increase payments significantly in order to provide sufficiently attractive economic 'entrance' values that cover perceived income losses as well as transaction costs. There are a number of objections to this solution, though. Firstly, subsidy schemes tend to exhaust national budgets for environmental purposes rather quickly. Secondly, at the same time as the use of AES is encouraged by EU regulation, the regulation sets a ceiling on the remuneration scheme of 20 per cent above direct costs, which necessarily limits the compensation for transaction costs. Thirdly, increasing payments in subsidy schemes does not ensure increasing scheme attractiveness for all farmers, especially for those who do not optimize only in economic values. Hence, increasing farmers' participation rates by simply increasing subsidies may not be a viable solution. An alternative solution that is pursued in the present paper is to try to identify requirements that farmers perceive to be less restrictive and thereby

possibly reduce farmers' transaction costs and payments necessary to attract farmers' interest in the AES instead.

2. The choice experiment approach

2.1 State of the art

For decades, economic valuation methods have been used to elicit consumer preferences within marketing and transport economics. Also, within environmental economics, a large number of studies on how consumers value environmental benefits of various policy initiatives have been conducted. It is only recently that studies applying the same techniques have been used in experiments to elicit farmer preferences for AES (Borch and Vedel, 2010; Vedel et al., 2010; Espinosa-Goded et al., 2010; Ruto and Garrod, 2009; Ducos et al., 2009; Vanslebrouck et al., 2002; Wynn et al., 2001). Indeed, these few studies provide promising new ways to elicit farmers' preferences for and rankings of different requirements. Apart from studying farmers instead of consumers, this new line of studies often investigate willingness-to-accept (WTA) compensation as opposed to most choice experiments that have been used to elicit willingness-to-pay (WTP) for desirable goods or services. The difference between WTA and WTP may be significant in this context as behavioural research has shown systematically lower values on gains over losses (Kahneman and Tversky, 1979). This might explain why studies within the WTP approach may yield lower estimates than choices valued as willingness to accept compensation.

Ruto and Garrod (2009) investigated the role that scheme design can play in encouraging farmers to participate in AES. Their study involved 10 European countries

188 – not including Denmark. They investigated farmer preferences for four specific scheme
 189 features: Contract length (5, 10, 20 years), flexibility in terms of what areas of the farm
 190 are entered into the scheme (yes, no), flexibility in undertaking some of the measures
 191 required under the scheme (yes, no), average time spent on paperwork/administration
 192 (less than 2 hours per week, 2-5 hours per week, or more than 5 hours per week). All
 193 four scheme features were found to be significant determinants of farmers' decisions to
 194 participate in AES. By specifically interacting farm factors with contract length, they
 195 found that age, education, successor, rent and finance were negatively related to
 196 contract length, whereas environmental concern and farm size were positively related.
 197 Espinosa-Goded et al. (2010) found that Spanish farmers were more willing to
 198 participate in AES that only required low levels of involvements (small restrictions on
 199 farm management and small payments) and that using fixed payment instead of variable
 200 payments could substantially reduce overall payments. Ducos et al. (2009) found that
 201 fixed transaction costs was a significant barrier to farmers' interest in AES –
 202 particularly for small farms – and suggested that providing payments as lump sums, as
 203 well as yearly payments, might decrease overall payments and at the same time increase
 204 participation rates. Using contingent valuation, Vanslebrouck et al. (2002)
 205 investigated Belgian farmers' preferences for increasing landscape values. They
 206 identified a group of farmers who were simply not interested in participating in a
 207 voluntary agreement (even though they could set the price themselves). Another group
 208 of farmers were generally susceptible to participating and their willingness to participate
 209 increased if they were informed about the environmental benefits involved.
 210 Furthermore, similar to Espinosa-Goded et al. (2010), they found that many farmers
 211 prefer low-involvement agreements (even though the payments were also lower). Even

so, the study found that buffer zones signalled sloppy farm management to many farmers. Using a logit model, Wynn et al. (2001) concluded that changes in behaviour was primarily determined by the interaction of the scheme structure with the farm production context as well as the availability of information.

These contributions point towards the possibility of farmers being willing to trade off payments for less burdensome scheme requirements (less paperwork, shorter contracts, etc.), thereby possibly increasing participation rates in AES without increasing government expenses to the schemes. In particular, both qualitative and quantitative studies suggest that flexibility is valuable. However, flexibility can be related to many decision levels, ranging from flexibility in the overall contract terms and the environmental goals that are pursued, to flexibility in practical management decision - and more detailed information is needed on how farmers rank specific types of flexibility.

To this end, we focus especially on eliciting how farmers rank flexibility in overall contract terms vis-a-vis flexibility in practical management. A very recent study on Danish landowners' interest in voluntary long-term afforestation schemes suggested that landowners had a strong preference for an option to renounce their contract within five or ten years; the preference was strong enough that they were willing to forego some level of subsidy. Likewise, they were willing to accept lower subsidies in return for less monitoring of contracts by authorities. Furthermore, landowners required lower subsidies when the purpose of afforestation was to protect biodiversity or groundwater compared to recreational purposes (Borch and Vedel, 2010; Vedel et al, 2010). These

studies are particularly interesting in relation to our study, as some of the investigated scheme features are similar – although their focus is on forestry and long term contracts whereas our study focuses on short term contracts related to agricultural production.

2.2 Method

The underlying assumption when estimating farmers' valuation of scheme features is that farmers' choices between subsidy schemes, depend on the specific requirements of the subsidy schemes (including the subsidy payments). This is in line with the Lancasterian Consumer Theory (Lancaster, 1966), which along with the random utility theory (Luce, 1959; McFadden, 1974) is the basis for choice experiments. According to Lancaster, the (indirect) utility V_{ij} that individual i achieves from good j is the sum of the utilities obtained from each of the K characteristics s_{kij} where $k= 1, 2, \dots, K$. We assume that the utility V_{ij} is an additive function of scheme features and can be written as follows:

$$V_{ij} = \beta_{1i}s_{1ij} + \beta_{2i}s_{2ij} + \dots + \beta_{Ki}s_{Kij} \quad (1)$$

Random utility theory is based on the assumption that individuals make choices according to a deterministic part along with some degree of randomness. Allowing U_{ij} to represent the random utility that individual i places on alternative j , V_{ij} now represents the deterministic component of the utility function and ε_{ij} is a random variable that captures the unsystematic and unobserved random element of individual i 's choice (Hanley et al., 2005; Holmes and Adamowicz, 2003). We will assume throughout the paper that the error terms are independent identical Gumbel distributions

sometimes also called a double exponential distribution². An alternative specific constant (ASC_j) capturing the (systematic) utility of omitted variables is included. The ASC_j is modelled as a dummy that takes the value 0 if one of the hypothetical alternatives is chosen and 1 if ‘none of these’ are chosen. Based on this model specification, a positive value of the ASC-dummy suggests the existence of some omitted variables that have a positive effect on the farmers’ utility of choosing ‘none of these’, see Adamowicz et al. (1998) and Meyerhoff and Liebe (2009). Hence, the random utility U_{ij} can be represented as follows:

$$U_{ij} = \beta_{ASC_j} ASC_j + \beta_{1i} s_{1ij} + \beta_{2i} s_{2ij} + \dots + \beta_{Ki} s_{Kij} + \varepsilon_{ij} \quad (2)$$

In a standard logit specification, all parameter coefficients are fixed. This assumption corresponds to a model where a homogenous population is assumed (or where the preferences of an average farmer are estimated). In the present model, only the subsidy parameter is fixed. This assumption allows straight forward calculations of the distribution of WTA. A random parameter model, as we apply for all features except the subsidy parameters, allows for variations in how the individual farmers value the scheme features, see e.g. Goett et al. (2000) for a discussion of this assumption. As it is expected that farmers’ valuations of the features can assume positive as well negative values, a normal distribution is used to capture the heterogeneity in the population. The size of subsidy is modelled as a continuous variable and all other features are modelled as effect coded dummy variables. In order to measure preferences for all scheme features in the same unit, i.e. money, we estimate the marginal substitutions between

²The cumulative distribution function of a Gumbel distribution for x given the parameters a and b can be written as $F(x;a,b) = \exp(-\exp((a-x)/b))$, see Train (/2002)

scheme requirements and the subsidy size. Thereby, we are able to estimate farmers' WTA lower payments in return for less restrictive scheme requirements. The software package Ngene 1.0 is used to create the design. It is optimized with respect to C-efficient estimations of main effects. All farmers are confronted with the same 8 choice sets. A random parameter logit model is estimated using the software package Biogeme (Bierlaire, 2003).

2.3 Our study - design and implementation

The specific scheme features included in the present study are inspired by findings from earlier studies, as well as by our own findings from a previous survey sent to a larger sample of farmers that included the farmers in the present study. In the previous survey, farmers were asked about the importance of a range of factors related to subsidy schemes for reducing the environmental effects of pesticide use. Results are shown in Table 1. They show that the largest number of farmers categorized 'amount of paper work' as very important – a total of 50 % indicated that this parameter was very important in their decision to participate in a subsidy scheme. Uncertainty about being locked into long term agreements was categorized as a very important decision parameter by 47 % of the respondents, and 43 % of the farmers found it very important that a subsidy would cover more than direct costs. Also of importance – but less so – was the degree to which the farmer's ability to plan his field management was restricted (30 % stated this as being very important) and the effect on the environment (23 % thought this was very important).

INSERT TABLE 1 HERE

These results inspired the design of the schemes used in the choice experiment. The scheme features and overall design were subsequently tested for validity in a focus group interview with Danish farmers. An overview of the exact formulation of the scheme requirements and their levels is provided in Table 2.

INSERT TABLE 2 HERE

Table 2, together with a short introduction, was presented to the respondents in the choice experiment. The introduction explained the benefits to nature of buffer zones. Also, based on experiences from the focus groups, it was specifically stressed in the text that they should consider the subsidy schemes as being independent and therefore, not covered by cross compliance. The size of payments ranged from 134 Euro/hectare/year (which is the present payment level for implementing buffer zones along waterways that was considered to be a lower bound due to the limited uptake) to 510 Euro/hectare/year (which was similar to the yearly hectare premium used for establishing wetlands which has been a much greater success than other subsidy schemes). Each respondent was asked to complete 8 choice tasks. The precise text and an example of a choice situation are presented in Appendix A and B, respectively.

Note that all features except the price can assume two levels. As one level is used as a reference level, only one parameter estimate for each scheme feature is estimated, which

represents the amount of payment that the farmers are willing to forego in return for a less restrictive requirement.

3. Results

3.1 Descriptive statistics

The survey was carried out in December 2009 and January 2010 among the Nielsen Company's farmer web panellists. A total of 486 responses were obtained (response rate of 45 %). Of these, 42 respondents were eliminated from the econometric analysis (see below), while the remaining 444 respondents (totalling 3552 observations) were used in the estimations.

The alternative 'none of these' was chosen 22 % of the time, and 14 % of the farmers (68 farmers) chose 'none of these' every time. Out of these, we identified 42 respondents who had chosen 'none of these' every time and at the same time stated that this was because subsidy schemes had nothing to do with real farming. This group of respondents were categorized as protesters and eliminated from the analysis³. Farmers, who consequently chose 'none of these' because they thought that the offered subsidy schemes were too unattractive, or they were too alike, were kept in the data set. Younger farmers and large farms are over-represented in the sample compared to the overall farmer population in Denmark. Therefore, we can't generalize the results to the Danish farmer population of today, but as the trend is that the average farmer is younger

³We defined protesters as respondents who chose none of these without considering the actual offers made by the hypothetical subsidy schemes. Therefore, farmers who argued that subsidies were not in accordance with real farming (and who every time chose none of these) were expected to reject the offered subsidy schemes without considering the actual subsidy schemes.

and farms become larger, the results can be considered to be robust regarding the future population of Danish farmers. The overrepresentation of large farmers was in part a deliberate choice as these farmers represent a larger share of the farmed land which is relevant in a regulatory context.

Approximately 9 % of the respondents indicated that they had previously participated in subsidy schemes, which corresponds to the actual rate of participation in existing subsidy schemes. Out of the respondents, around 25 % of the farmers indicated that they do not have hedgerows on their farms, which leave 75 % of the farms to be pre-qualified for the proposed subsidy schemes if they were really implemented. We confronted the farmers with six statements concerning their perceptions of subsidy schemes in order to elicit underlying barriers towards AES that were not directly related to specific scheme requirements. This showed that a majority of the farmers did not consider subsidy schemes to be easily obtained income. We also found a great deal of uncertainty among farmers about the consequences of enrolling in subsidy schemes in relation to how one subsidy scheme would be affected by other schemes, whether existing subsidy schemes were subject to the EU's cross compliance regulation, and to what extent authorities could be trusted (see Table 3).

INSERT TABLE 3 HERE

3.2 Estimation results

The econometric estimations indicated that all of the investigated scheme requirements had a significant effect on farmers' utility. The results are shown in Table 4. An

'adjusted $\rho^2 = 0.26$ ' suggests that the model fit is indeed acceptable (Louviere et al., 2000).

INSERT TABLE 4 HERE

Regarding farmers' values and rankings of the individual requirements, the results are most easily communicated by looking at an average farmer's WTA compensation for complying with the individual requirements (last column in Table 4). For example, the model estimates indicate that an average farmer is willing to give up 43 Euro/ha/year for being able to use a flexible zone width instead of being restricted to using 6 meter zones/ha/year. This amount shall be seen relative to the offered subsidies that were between 134 and 510 Euro/ha/year. Large and significant standard deviations of the normally distributed coefficients indicate that there is a great deal of heterogeneity in how farmers value the costs of the requirements. To continue our example, the standard deviation in how farmers value flexible zone width is 106 Euro/ha/year.

Regarding the other individual requirements, the results show, that farmers are willing to accept a reduction in payment of 128 Euro/ha/year in return for a shorter contract period (1 year vs. 5 years), 137 Euro/ha/year if they get an opportunity to break the contract once a year, 110 Euro/ha/year if they can use fertilizer in the buffer zone, and 52 Euro/ha/year if they get free-of-charge assistance from the extension service with the application forms. Needless to say, farmers' willingness to enter the schemes increase with higher subsidies.

The ranking reveals a certain pattern in how important the requirements are perceived to be. Features related to flexibilities in contract terms seem to be the most important characteristics. This group of requirements includes the option of being released from the contract, as well as short-term contracts. The second group of requirements involves flexibility in the practical management such as being allowed to use fertilizer, flexibility in zone width and being offered assistance free of charge in administrating the actual application for joining the subsidy scheme. It should be noted though, that being allowed to use fertilizer seems to be far the most important characteristic in the second group.

The significant and positive ASC indicates that there are some variables that are not included in the model, which induce farmers to prefer not to join any of the offered subsidy schemes. These omitted variables might include other types of requirements that could have been included that would have been more attractive for farmers (or more attractive levels of the included requirements), but they might also reflect a general reluctance to join subsidy schemes. To this end, the ASC may be interpreted as the entrance value needed to make farmers interested in joining at least one of the subsidy schemes described in the choice experiment. The estimated entrance value of 104 Euro/ha/year for an average farmer constitutes 77 % of the payments presently offered to Danish farmers for implementing buffer zones along streams and lakes. Note, however, that the large heterogeneity across farmers complicates the interpretation of ASC as a common entrance value.

We tested for heterogeneity in the mean with respect to farm size (e.g. whether farms with more than 200 hectares, which comprises 21 % of the sample, behaved differently) and previous participation (e.g. whether farmers who participated in an AES in 2009, which comprised 9 % of the sample, behaved differently than those who had not). These relationships were analysed by testing for interactions-effects between the values that farmers assigned to the individual features vs. farm size and previous participation. We found no systematic relations.

4. Discussion and conclusion

Our descriptive results suggested that 72 % of the Danish farmers disagree with or are neutral towards the statement that subsidy schemes are an easy source of income. This result closely matches the findings in Mettepenningen et al. (2009), where two-thirds of the European respondents stated that the total costs they incurred by AES exceeded the compensation payment. We also found that there is a great deal of uncertainty among farmers concerning the consequences of enrolling in subsidy schemes with respect to the degree of overlap with other subsidy schemes, and the extent to which cross compliance might be put into force. Furthermore, we found a considerable lack of trust in authorities. These are fundamental barriers for increasing farmers' interest in AES and we suggest that they need to be addressed if further uptake is a political goal.

Regarding payments, we found that a payment above and beyond direct costs is a necessary condition for showing interest in a subsidy scheme, which is consistent with the existing literature. More interestingly, the choice experiment indicated that the vast majority of farmers (86 %) are willing to trade off scheme requirements against the size

of the subsidy. From a policy point of view, these results are promising, as they suggest that it is possible to make most of the farmers interested in implementing buffer zones not only by offering them higher payments, but also by offering them less restrictive scheme requirements. The remaining 14 % of the farmers in the specific case study consistently chose ‘none of these,’ which clearly indicates that these farmers might be difficult to motivate to enrol in subsidy schemes.

We acknowledge that the monetary values that farmers’ place on accepting specific requirements are indeed case specific. As a consequence, the robustness of the results needs to be addressed in future studies. Nevertheless, our results concerning increased use of farm advisors, farmers’ ability of valuing different types of flexibility, and our attempt to place a monetary value on farmers’ reluctance to engage in regulatory subsidy schemes have a potentially broader application platform. Furthermore, the detailed focus on individual scheme requirements, that is encouraged by using choice experiments, opens up for new ways to analyse possible efficiency improvements of farmer regulation – and this insight can be used for a wide range of regulatory challenges.

The results that most directly can contribute to more efficient designs of environmental policy include 1) identification of the importance of letting farmers be released from their contracts before they expire or simply issuing contracts with shorter time horizons, 2) estimation of a monetary value that farmers place on being released from that part of the administrative burden that is linked to the AES application procedure through increased use of farm advisors and 3) estimation of a monetary value related to farmers

overall reluctance to participate in voluntary agreements with the public authorities.

These issues will be discussed in turn.

We found that the overall flexibility of the contract (as represented by the features ‘contract length’ and ‘ability to cancel the contract before the expiration date’) might be more important to farmers than the practical restrictions in flexibility that a contract induces (to what extent fertilizer can be used in the buffer zone, whether buffer zone width are flexible and whether practical assistance in the application process is offered). Earlier findings confirm that shorter contracts are generally preferred to longer. The importance of the release-option is also found by Borch and Vedel (2010) in relation to afforestation schemes. They suggest that the release-option provides the landowners with a feeling of ‘leaving the back door open’. Likewise, our focus group interviews indicated that the open back-door may help reduce uncertainty regarding impact on and from other schemes and lack of trust in regulatory authorities. At the same time, Borch and Vedel (2010) found that the release-option was only valuable for land-owners who did not already have forest on their land. More generally, these results indicate that offering a release-option might be a relatively cheap way for the regulatory authorities to induce farmers to participate because, once they have entered the voluntary subsidy scheme, they are less motivated to use the release-option than they anticipated they would be. This is similar to holding an insurance policy – it is very valuable to have the opportunity – also when it is not used. These benefits of offering farmers a contract that can be denounced before expiration date must of course be weighed against the costs in terms of increased uncertainty about reaching environmental goals.

Second, the choice experiment indicates that farmers are able to place a monetary value on being released from parts of the administrative burden, and in particular, that they consider the use of assistance free of charge for the application procedure to be a possible solution. In other words, free of charge assistance might make farmers willing to accept a lower payment for enrolling in a scheme. Needless to say, the potential benefits in a specific policy situation depends on whether the costs of offering assistance free of charge to farmers are lower than the benefits as they are perceived by the farmers. However, as specialisation typically involves comparative efficiency advantages, it is likely that a farm advisor can carry out administrative tasks more efficiently than the farmer. From a policy perspective, the results suggest promising synergy effects in the sense that increased communication between farmers and the extension service in relation to the specific administrative task might, at the same time, be a way to reduce some of the aforementioned barriers related to uncertainty among farmers concerning the consequences of enrolling in subsidy schemes.

Third, as the alternative specific constant in the choice experiment can be interpreted as the value of omitted variables, we suggest that it might reflect a general reluctance to join subsidy schemes. That is, it captures a dis-utility of enrolling in a voluntary subsidy scheme that is not linked to the specific scheme features but instead to other factors that are not captured in the statistical model. As there is empirical evidence from our study as well as earlier studies that farmers are often motivated by other factors than strictly profit maximization (professional pride, family traditions, mistrust in authorities etc.), it is tempting to interpret the alternative specific constant as encompassing such non-economic barriers. This is, to the authors' knowledge, the first attempt to quantify the

entrance value that seems to be needed to overcome barriers for entering voluntary agreements.

At this point, it is important to note that the estimated compensation values for the individual scheme features may not directly reflect what we can expect farmers to accept in a real setting, due to various methodological issues that are associated with stated preference methods. Firstly, it is commonly found in stated preference studies that the hypothetical nature of a choice experiment may induce respondents to overstate their required compensation (hypothetical bias). In particular, hypothetical bias might involve strategic responses, too much focus on the subject in question compared to their behaviour in non-hypothetical settings, etc. In the present paper – the hypothetical bias issue is attempted reduced through different actions – e.g. cheap talk script, the use of choice experiment as valuation method and the choice of a type of voluntary agreement that all farmers in principle are familiar with. Moreover, it should be kept in mind that the estimated entrance value is indeed significantly higher than the current level of subsidies, and the current subsidy levels clearly have not been adequate to entice farmers to enter the schemes, cf. above. This lends some credibility to the results obtained in the choice experiment. Secondly, self-selection related to participation in the survey, may entail that respondents participating in the survey are more interested in AES than the average farmer, which could also bias the results. These methodological issues are constantly being addressed and ways to reduce hypothetical bias are found – but the problem will always exist so results must be interpreted accordingly.

Regardless of whether the buffer zones are going to be implemented as part of a voluntary agreement or as a compulsory regulatory tool, our findings provide valuable information. It almost goes without saying, that in a voluntary context, it is important for the success of the subsidy schemes that they are made as attractive to the farmers as possible in order to motivate farmers to participate. Looking at compulsory buffer zones (or other requirements), the benefits of motivating the farmers are not measured in participation rates but rather (and equally important) in reducing the need for monitoring and control.

Based on our findings, we can point towards some obvious routes for further research in how to design AES schemes in order to increase farmers' willingness to participate. In relation to removing fundamental barriers towards AES, we can point towards the need for increasing knowledge of how farmers' trust in authorities can be improved and to what extent cross compliance can be used as a compliance tool, instead of deterring farmers from participating. In relation to improving the design of AES, several studies have shown that information concerning environmental goals of the AES creates incentives for participating. However, a related issue concerning the potential effect of offering farmers feed-back on how their contribution has affected the environment, could potentially be an incentive creating factor as well – and this has, to our knowledge, not been addressed yet. In addition, it would be beneficial for future designs of AES to identify which requirements are simply unacceptable (lexicographic preferences) and which requirements are unattractive, but can be compensated. These issues are related to the suggestions by Ruto and Garrod (2009) that future research is required to identify how closely AES payments can be correlated with the opportunity

costs of participation for different groups of farmers. From a methodological angle, previous research on consumer preferences (Moerkbak et al., 2010 presents an overview) has clearly shown that the estimated willingness-to-pay values are sensitive to the chosen payment-vector. The extent to which this result carries over to farmers' preferences is indeed also an important topic for future research.

We have focused on how farmers valued the individual characteristics of an agreement. However, in order to evaluate the efficiency of agreements, we also need to assess the impacts on the environment. We found that farmers attached different costs to the requirements - but the environmental effects also differ. The overall picture is that the more hectares that are farmed in an environmentally friendly way and the longer time pesticides and fertilizers are not used, the greater are the environmental benefits. To this end, the present approach to assess farmers' preferences opens up for not only identifying trade off's between payments and individual requirements, but also for identifying environmental consequences of the individual requirements. For example, we found that the average farmer needs to be paid 128 Euros in order to be just as well off when enrolling in a 5 year contract as in a 1 year contract. The million Euro question is now whether the environmental value of a longer contract will exceed the costs? This requires valuation of the environmental benefits, which is also a challenge for further research.

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688

689 **Appendix A**

690

691 The following text was used as an introduction to the choice experiment.

692

693 “New subsidy schemes are offered for implementing buffer zones along hedgerows.
694 Buffer zones along hedgerows provide space for flowering herbs and insects – and
695 provide food for (among others) grey partridges and hares. It is important for the
696 positive effects on the nature that the buffer zones are cut every year in late august. The
697 buffer zone area is entitled to direct payments. The new subsidy scheme is not covered
698 by cross compliance. Therefore, the size of the payments can be considered
699 independently from the direct payments. The new subsidy schemes differ from each
700 other with respect to the following six characteristics. On the next page, we show you a
701 table that provides an overview of the subsidy schemes you will be confronted with.”

702

703 **Appendix B**

704

705 An example of a choice set

706

	Subsidy scheme A	Subsidy scheme B
Buffer zone width	6 m	Flexible width (between 6 and 24 m)
Contract length	1 year	5 years
Option to cancel contract (without costs)	Yes	No
Changed agricultural practice	Pesticide-free	Pesticide-free
Application method	Usual application procedure	Free assistance
Size of subsidy	336 DDK	228 DDK

707

708 Which of the subsidy schemes do you prefer?

709 • Subsidy scheme A

710 • Subsidy scheme B

711 • None of these

712

713

714 **Table 1**

715 Distribution of farmers' perceptions of AES (measured in % of population).

How important are the following factors for your decision to participate in AES?	1	2	3	4	5	Don't know
The subsidy should cover more than the direct costs	3	4	16	31	43	3
How much participation limits field planning	5	6	24	29	30	6
The amount of paper work	3	4	13	27	50	3
Uncertainty that a voluntary agreement might be made compulsory	3	4	16	25	47	5
Believe in the benefits for the environment and nature	7	11	27	28	23	4

716 Note: A population of 1164 farmers. The scale ranges from 1-not important to 5-very important.

717

Table 2.

Overview of possible requirements in the subsidy schemes used as attributes and levels in the choice experiment.

Type of requirement	Scheme requirement (attributes)	Detailed scheme requirement (attribute levels)
Flexibility in contract terms	Contract length	- 1 year - 5 years
	Release option	-can be released from contract without costs once a year - cannot be released from contract
Flexibility in practical management	Buffer zone width	- between 6 and 24 meter (possibly the width of your mover) - 6 meter
	Changed agricultural practice	- pesticides cannot be used in buffer zones - pesticides or artificial manure cannot be used in buffer zones
	Application method	- assistance free of charge from extension service to send in application form - application for subsidy on common application form
Economic incentive	Size of subsidy (Euro per hectare per year)	134 Euro, 228 Euro, 336 Euro, 510 Euro

Notes: Scheme requirements stated in **bold** are used as reference levels in the econometric estimations. It should be noted that the first column, which groups the 6 scheme attributes into 3 overall categories, is included in the present paper, but was not presented to the respondents.

725

726 **Table 3.**

727 Distribution of farmers' perceptions of subsidy schemes (measured in % of population)

Please state to what extent you agree or disagree with the following statements	1 - completely disagree	2 – partly disagree	3- neutral	4- partly agree	5- completely agree	Don't know
My experiences with subsidy schemes are bad	5	20	39	20	9	7
It is an easy way to help the environment	8	20	35	23	6	8
It is an easy way to earn money	14	22	36	15	5	8
It is difficult to identify how various subsidy schemes affect each other	1	7	16	43	20	5
I am uncertain about the consequences for direct payments (cross-compliance)	6	13	28	30	14	8
I do not trust the authorities	8	17	39	20	12	5

728 Note: A population of 444 farmers.

Table 4.

Farmers' WTA scheme requirements for implementing pesticide free buffer zones

Mean of parameters	Coefficient	Robust Std err	p-value	Euro/ha/ year
Flexible zone width	0.170	0.045	< 0.001	43
Shorter contract period	0.499	0.043	< 0.001	128
Release option	0.534	0.057	< 0.001	137
Using fertilizer in the buffer zone	0.430	0.060	< 0.001	110
Assistance with application form	0.203	0.052	< 0.001	52
Size of subsidy	0.00109	6.9E-05	< 0.001	
ASC (alternative specific constant)	0.817	0.284	< 0.001	104
Std. deviations of parameters				
Flexible zone width	0.416	0.063	< 0.001	106
Shorter contract period	0.471	0.049	< 0.001	120
Release option	0.461	0.082	< 0.001	118
Using fertilizer in the buffer zone	0.877	0.071	< 0.001	224
Assistance with application form	0.443	0.056	< 0.001	113
ASC	3.46	0.224	< 0.001	442
Adjusted ρ^2	0.267			

Notes: A population of 444 farmers. All coefficients are normally distributed except for size of subsidy, which is fixed. All variables are effect-coded except for ASC, which is dummy-coded and the price, which is a continuous variable. Coefficients relating to effect-coded variables are multiplied by 2 before division with price-coefficient when Euro/ha/year is calculated. The reference levels for the Euro/ha/year (last column) are chosen such that they are all positive, while the reference levels for the parameter values (second column) are as specified in Table 1. We used simulations with 2000 Halton draws when estimating the random parameters.