How to increase the effectiveness of agri-environmental subsidy schemes through knowledge of farmer perceptions-a choice experiment on pesticide free buffer zones

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Abstract

Danish farmers have been far less interested in agri-environmental subsidy schemes than anticipated. We use choice experiments to estimate 486 Danish farmers' preferences for a number of policy relevant scheme-characteristics. Subsidy schemes for pesticide free buffer zones along hedgerows are used as a case and analysed using a random parameter logit framework. By quantifying farmers' preferences in monetary values, we are able to assess the relative importance of individual scheme-characteristics. Farmer's assessments of the administrative burden are captured by estimating how they value free-of-charge assistance for the application procedure. To our knowledge, this measure of administrative burden has not been tested before. Our results indicate that payment size was perceived to be the most important scheme characteristic narrowly followed by flexible contract terms (an option to cancel the contract and contract length) and still of significant importance but less so are practical management restrictions (choice of buffer zone width, using fertilizer, and reduced administrative burden).

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

1. Background

Denmark has a long tradition of regulating the agricultural use of approved pesticides. The instruments have been a combination of pesticide taxes and voluntary measures such as subsidy schemes for pesticide free production, general information campaigns, subsidised advisory services at farm level of how to reduce pesticides use, subsidised pesticide reducing decision support systems, and publicly financed research in pest management. Particularly agri-environmental subsidy schemes (AES) have been widely used as they are encouraged by the Rural Development Fund under the present EU Common Agricultural Policy. 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 safeguard aquatic environment and to avoid leaching of pesticides to the ground water – but with limited success among farmers (Christensen et al 2007; Pedersen et al 2007). The limited uptake of AES among farmers has increased interest in identifying factors that determine farmers' interest in AES.

Danish farmers successfully decreased their pesticide use from around 7000 tonnes in 1981 to around 4000 tonnes of active ingredients in 2008 (Environmental Protection Agency, 2009). However, a large part of this development has been driven by the introduction of more effective pesticides per weight unit and as a consequence the pressure on the environment has not decreased at the same rate as the volume of pesticides. In order to obtain a better measure of environmental effects, the so-called treatment frequency index (TFI) was introduced and is now the main Danish indicator of the use of approved pesticides[1]. The latest Pesticide Plan III underlined that the new goal was to reach a TFI

[1] The TFI represents the number of pesticide applications in the cultivated areas (calculated from the traded amount of pesticides that year), provided that a fixed standard dose is used. Uncultivated fallow fields, organically cultivated fields

of 1.7 at the end of 2009 as proposed by the Bichel Committee (Ministry of Environment & Ministry of Food, Agriculture and Fisheries 2003). However, the TFI has increased substantially since 2003 (Table 1).

Table 1. Development in the Danish pesticide use from 1997 to 2008 (measured as TFI)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
TFI	2.63	2.40	2.45	2.07	2.19	2.10	2.33	2.39	2.49	2.52	2.51	3.16

TFI: Treatment frequency index. Source: Environmental Protection Agency (2000; 2003; 2006; 2009)

Evaluations of the effectiveness of the pesticide plans (and AES in general) point to multiple explanations of what went wrong. One line of argument suggests that farming conditions have changed (changed input/output prices, changed crops, more aggressive pest attacks, etc.) and as a consequence, the economic incentives have not been high enough to induce farmers to change behaviour. For the Danish case, these arguments apply to the insufficient effect of the pesticide taxes as well as to the sparse interest among farmers in signing up for subsidy schemes for pesticide-free production (Christensen et al. 2007; Pedersen et al. 2007; Economic Council 2010). Another line of arguments pursued in the international literature, concerns transaction costs. Falconer (2000) suggested that transactions costs serve as barriers such that farmers' perceived costs of complying with restrictions in a voluntary agreement exceed the values of their production losses. Mettepenningen et al. (2009 p. 663) estimated private transaction costs (defined as costs that are not related to changed profits) for European farmers as 14 % of total AES-related costs which was 'considerably higher than indicated by previous research'. Both studies suggest that ways to reduce these transaction costs should be investigated in order to increase AES uptake. A particular motivation for research in private transaction costs is that AES payments under the EU common Agricultural Policy can exceed the costs of lost production by 20 % under the condition that the additional payments are used to cover documented transaction costs. A third line of arguments has recently emerged suggesting that farmers do not only optimize in economic terms but are also driven by other motives such as professional pride in high yield etc. (Nielsen, 2009; Burton et al. 2008; Mettepenningen et al. 2007; Gasson 1973). Hence, there might be barriers in addition to the insufficient payment sizes and to what extent private transaction costs are compensated that need to be overcome before participation rates can increase.

Fundamentally, participation barriers can be addressed from two different angles. One solution is to increase payments significantly in order to provide sufficiently attractive 'entrance-values´. However, there are a number of objections to this solution. Firstly, subsidy schemes tend to exhaust national budgets for environmental purposes rather quickly. Another obstacle against increasing payments is that, at the same time as the use of AES is encouraged by EU regulation – it is also restricted because of the 20 % ceiling on transactions costs. A third problem with increasing subsidy schemes is that it might not even affect the attractiveness of the schemes for farmers, especially those who are less motivated by non-economic values. Hence, increasing farmers' participation by simply increasing subsidies may not be a viable solution. An alternative solution is to reduce transaction costs or non-economic barriers instead. Increasing interest has been shown towards understanding the determinants of when AES become a success – and when they do not. Several sociological studies have focused on identifying factors that affect farmers' propensity to participate in AES. These studies indicate that contract specific factors such as flexibility and farmers' levels of information are important (Wynn et al. 2001) just as shorter contracts are typically preferred to longer. Also, farmer and farm factors such as age, education, farm size and financial situation have been found to have a significant effect on participation rates (Siebert et al. 2006 provides an overview). Also having a social network that is positive towards subsidy schemes is found to affect farmer attitudes towards AES (DeFrancesco et al. 2008).

The main purpose of the present paper is to elicit farmers' preferences for a number of policy relevant characteristics of an AES. More specifically, we conduct a choice experiment in order to quantify Danish farmers' preferences for subsidy schemes for pesticide free buffer zones along hedgerows. Thereby, we are able to estimate a monetary value of farmers' potential barriers for reducing pesticide use. The barriers include the farmer's perceived costs of production loss, transaction costs or costs of compromising professional pride. This methodological approach is inspired by Ruto & Garrod (2009). The intentions are that the results of our case study provide input to solving the ongoing problems of fulfilling the goals in Danish pesticide regulation. Our experiment includes a measure that has not been tested before, namely the use of farm extension service as a means to reduce transaction costs. The case and the statistical method employed will be presented below, followed by the empirical analyses leading to results that are discussed and concluded upon.

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and constant grass fields are not defined as cultivated fields and therefore these types of fields are held out of the TFI calculation (Freier & Boller 2009, p.442)

2. The choice experiment approach

2.1 Earlier studies

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 the environmental benefits of various policy initiatives have been conducted but studies that seek to use the same techniques to elicit *farmer* preferences for policy initiatives have only recently entered the scene. Such studies have typically focused on eliciting farmers' preferences for AES. Indeed, these few studies provide promising new ways to force the farmers to elicit their preferences for and rankings of competing goals (such as for example, flexibility in farm management versus obtaining subsidies for undertaking specific changes in production).

We found a handful of studies using choice experiments to elicit farmer preferences for AES. Ruto & Garrod (2009) investigated the role that scheme design can have on encouraging farmers to participate in AES. Their study involved 10 European countries – not including Denmark. They investigated farmer preferences for 4 specific scheme characteristics: Contract length (5, 10, 20 years), flexibility in what areas of the farm are entered into the scheme (yes, no), flexibility in undertaking some of the measures required under the scheme (yes, no), average time spent on paperwork/administration (less than 2 hours per week, 2-5 hours per week or more than 5 hours per week). All four scheme attributes were found to be significant determinants of farmers' decisions to participate in AES. By specifically interacting farm factors with contract length they found that age, education, successor, rent and finance are negatively related to contract length whereas environmental concern and farm size were positively related to contract length. Epinosa-Goded (2009) found that Spanish farmers where more willing to participate in AES when restrictions on farm management were small and that fixed payment could substantially reduce overall payments. Ducos et al. (2009) found that fixed transaction costs were a significant barrier to farmers' interest in AES – particularly for small farms – and suggested that payments were provided in lump sums as well as yearly payments might decrease overall payments and at the same time increase participation rates.

Using contingent valuation, Vanslembrouck et al. (2003) investigated Belgian farmers' preferences for increasing landscape values. They found a group of farmers who were simply not interested in participating in a voluntary agreement (even though they could set the price themselves), that farmers were more reluctant to participate if they did not understand the environmental benefits involved, that buffer zones signalled sloppy farm management, and that many farmers prefer low-involvement agreements (even though the payments were also lower). Using a logit model, Wynn et al. (2001) found that flexibility was important for farmers' decisions to participate in AES.

These contributions point towards the potentials for trading off payments with changed scheme requirements and thereby possibly increase participation rates in AES without increasing environmental budgets. In particular, the qualitative as well as the 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 the specific types of flexibility that farmers value the most. To this end, we especially focus on eliciting how farmer's rank flexibility in overall contract terms vs. 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 denounce their contract within five or ten years which could reduce required subsidies. Also, reduced control by authorities could reduce required subsidies. Furthermore, landowners required lower subsidies when the purpose of afforestation was to protect biodiversity or groundwater compared to recreational purposes (Broch & Vedel 2010; Vedel, Jacobsen & Thorsen 2010). The latter studies are particularly interesting in relation to our study as they involve Danish landowners and they support our hypotheses that contract length and a denounce option are valuable also in a short term context of pesticide-free low payment buffer zones as we investigate.

2.2 Method description

The underlying assumption in estimating farmers' valuation of scheme attributes is that the farmers' choice of subsidy scheme depends on the specific requirements of the subsidy schemes (including the subsidy payments). Hence, the underlying theory of CE is based on Lancaster's Consumer Theory (LCT) (Lancaster 1966) and random utility theory (Gravelle & Rees 1992, Luce 1959, McFadden 1974). 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 $k= 1, 2, \ldots, K$. We assume that the utility V_{ij} is an additive function of attributes and can be written as follows:

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

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.* 2002, Holmes & Adamowicz 2003). We will assume throughout the paper that the error terms are independent Gumbel distributions. An alternative specific constant (ASC_i) has been included which captures the (systematic) utility of omitted variables. The ASC is modelled as a dummy that takes the value 0 if one of the two hypothetical alternatives is chosen and 1 if 'none of these' is chosen. A positive value of the ASC-dummy would suggest the presence of some elements not included in the present model that have a positive effect on the farmers' utility of choosing 'none of these', see Adomowicz et al. (1998) and Meyerhoff & Liebe (2009). Hence, the random utility U_{ij} can be represented as follows

$$U_{ij} = \beta_{ASCi} ASC_i + \beta_{1i} s_{1ij} + \beta_{2i} s_{2ij} + ... + \beta_{Ki} s_{Kij} + \varepsilon_{ij} \quad (2)$$

In a standard logit specification, all parameter coefficients are fixed. A random parameter model, as we applied, allows for variations in how the individual farmers value the scheme characteristics. Normal distributions are assumed for all non-price attributes (zone width, contract length, contract cancelling, fertiliser use, and free assistance) as well as the ASC (see also Goett *et al.* 2000, Revelt & Train 1998). This means that farmer valuations of these attributes can take positive as well as negative values. In order to measure preferences for all attributes in the same unit, i.e. money, we estimate the marginal substitutions between non-monetary requirements and the subsidy size. Thereby, measures os *willingness-to-accept* (WTA) individual requirements are obtained. We assumed a constant price parameter, since this allows straight forward calculations of the distribution of WTA. The price is modelled as a continuous variable and all other attributes are modelled as effect coded dummy variables. The soft ware package Ngene is used to create the design. It is optimized with respect to C-efficient estimations of main effects given the restriction of 8 choice sets to each farmer and no blocks (http://choice-metrics.com/). A random parameter error correction model is estimated using Biogeme (Bierlaire, 2003).

2.3 Our study - design and implementation

Recent studies have focused on the usefulness of buffer zones to protect the terrestrial biodiversity (Bruus et al. 2008; Navntoft 2009). As buffer zones along hedgerows are not included in the present regulatory initiatives, the present study serves as useful input to future pesticide policies.

The specific scheme characteristics included in the present study are greatly inspired by findings from earlier studies as well as by our own findings from a previous survey sent to the same farmers. In that survey, farmers were asked about the importance of a range of factors related to subsidy schemes for reducing environmental effects of pesticide use. The amount of paper work was the factor that the largest number of farmers categorized as very important – a total of 50 % indicated that it was very important for a decision to participate in a subsidy scheme. Uncertainty about being forced into permanent agreements was categorized as very important 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 farmers ability to plan his field management was restricted (30 % stated that as very important) and the effect on the environment (23 % thought this was very important). Inspired by these results, we used a focus group to test specific formulations of scheme attributes that the group found meaningful and at the same time politically realistic. An overview of attributes used in the choice experiment is provided in Table 2.

Contract flexibility was captured by including different contract lengths and by introducing a yearly option to be released from the contract. Description of the administrative burden caused some initial problems as it was not possible to find hourly estimates that were meaningful across farmers. Instead the possibility to be released from the administrative burden by obtaining assistance from the extension service was found to be a satisfactory indicator of the how much weight a farmer would place on the administrative burden. In Denmark, the majority of farmers use the agricultural extension service for economic and field management advice as well as for applying for direct payment under the CAP. Hence, transaction costs involved in contacting an agricultural advisor for assistance for applying for an additional subsidy scheme are expected to be low. Variation in how much scheme requirements would limit actual field management was captured by introducing an attribute where artificial fertilizer might/might not be allowed in the pesticide free buffer zone. The policy importance of this attribute lies in the differences in environmental and economic effects of buffer zones depending on whether the buffer zones are 'only' pesticide free or whether they are also free from artificial fertilizer. Finally, the size of payments ranged from 1000 DDK (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 3800

DDK which was identified in the focus groups as sufficient for a dream-AES and in addition was similar to the yearly hectare premium used for establishing wetlands which has been a much larger success than other subsidy schemes).

Table 2. Overview over possible requirements in the subsidy schemes used in the choice experiment

Type of requirement	Scheme requirement (attribute)	Detailed scheme requirement (attribute level)
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	- 6 meter **- between 6 and 24 meter (possibly the width of your mover)**
	Changed agricultural practice	**- pesticides cannot be used in buffer zones** -pesticides or artificial manure cannot be used in buffer zones
	Application method	- application for subsidy on common application form **- free assistance from extension service to send in application form**
Economic incentive	Size of subsidy (Euro per hectare per year)	134 Euro, 228 Euro, 336 Euro, 510 Euro

Note: Attribute levels in bold are used as reference levels in the econometric estimations

Table 2 together with a short introduction was presented to the respondents. The introduction explained the benefits to nature of buffer zones and that the subsidy schemes should be considered as independent and not covered by cross compliance. Each respondent was asked to complete 8 choice tasks. It should be noted that the first column which groups the 6 scheme attributes into 3 overall categories is included in the table for illustrational purposes in the present paper and were not presented to the respondents. The precise text and an example of a choice situation are presented in appendix.

3. Results

3.1 Descriptive statistics

The survey was carried out in December 2009 and January 2010 within the Nielsen Company's farmer web panel. 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.

We report the most relevant descriptive statistics. The alternative none of these was chosen 22 % of the times. In order to eliminate potential protesters[2], we identified the group of farmers who chose none of these in all 8 choice situations. Out of these, 42 respondents chose none of these every time because they partly or completely agreed that subsidy schemes have nothing to do with real farming. Responses from 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. With respect to representativeness, there is an overweight of younger farmers and large farms in the sample.

A question concerning earlier participation in subsidy schemes revealed that 9 % of the respondents had previous experience which corresponds reasonably well with the actual uptake of existing subsidy schemes. 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. We confronted the farmers with six statements concerning their perceptions of subsidy schemes. We found an overweight of farmers who did not consider subsidy schemes an easily obtained income and we found that a great deal of uncertainty about the consequences of enrolling in subsidy schemes was present among farmers 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).

[2] We defined protesters as respondents who we expected chose none of these without considering the actual offers made by the hypothetical subsidy schemes

Table 3. Distribution of farmers perceptions of subsidy schemes, measured in % (N=486)

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 my direct payments (cross-compliance)	6	13	28	30	14	8
I do not trust the authorities	8	17	39	20	12	5

3.2 Estimation results

The econometric estimations indicated that all the investigated scheme requirements had a significant effect on farmers' utility. More specifically, flexible zone widths were preferred to a fixed 6 meter wide zone and 1-year contracts were preferred to 5-year contracts. Also, positive values were attached to the option to be released from a contract without costs, to be able to use fertilizer in the buffer zone and to obtain assistance in the practical application process. Also as expected, farmers placed a positive value on higher subsidies. The results are shown in Table 4. An 'adjusted $\rho^2 = 0{,}26$' suggests that the model fit is indeed acceptable – typically, anything above 0.2 is considered as a good fit (Louviere et al. 2000) even though there is still a great deal of variation to explain.

Table 4. Farmer WTA specific scheme requirements for implementing pesticide free buffer zones (N=444)

Mean values of attribute parameters	Coefficient	Robust Std err	p-value	Euro/ha/ Year
Buffer zone width	-0,170	0,045	~0	43
Contract period	-0,499	0,043	~0	128
Release option	0,534	0,05	~0	137
Using fertilizer in the buffer zone	- 0,430	0,06	~0	110
Application method	-0,203	0,05	~0	52
Size of subsidy	0,00109	6.9E-05	~0	
ASC (alternative specific constant)	0,817	0,284	~0	104
Standard deviations of attribute parameters				
Buffer zone width	0,416	0,05	~0	106
Contract period	0,471	0,05	~0	120
Release option	0,461	0,08	~0	118
Using fertilizer in the buffer zone	0,877	0,071	~0	224
Application method	0,443	0,06	~0	113
ASC	3,46	0,224	~0	442
Adjusted ρ^2	0,267			

Note: All coefficients are normally distributed except size of subsidy which is fixed. All variables are effect coded except price and ASC who are dummy coded. 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 2. We used simulations with 2000 Halton draws.

Analysing farmers' value and ranking of the individual requirements is most easily communicated by looking at the average farmer's WTA compensation for complying with each individual requirement by using money as a common denominator (last column in Table 4). All attributes except the price, can assume two levels. No absolute parameter values are estimated, only the increased value of facing a certain subsidy scheme relative to a reference level is

identified. For example, the estimated value of facing flexible zone width instead of 6 meter zones is 43 Euro/ha/year for an average farmer. 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 106 Euro/ha/year.

The ranking reveals a clustering in how important the requirements are perceived to be. *Flexibilities in contract specifications* seem to be the most important characteristics. This group includes the option of being released from the contract as well as short-term contracts. The second group involves *flexibility in the practical management* such as being allowed to use fertilizer, flexible zone width and being offered assistance 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.

To supplement the choice experiment, farmers were asked to state how each scheme characteristics had affected their choices. That exercise revealed that the importance of the characteristic could be ranked according to how many of the respondents had stated that the characteristic had affected their choice to a large or very large extent: Most important was payment size (57 % of the respondents stated that payment size had affected their choice to a large or very large extent – which still leaves 43 % who state that their choice was not greatly affected by the suggested payment increase), followed by the release option (53%), contract length (48%), zone width (36%), fertilizer use (34 %) and application method (23 %). These qualitative results confirm the quantitative estimations from the choice experiments. In addition, they place the subsidy size as the top ranked characteristic of a subsidy scheme.

The significant and positive alternative specific constant (ASC) indicates that there are some variables that are not captured in the model that 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 are 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 can represent the entrance value needed to make farmers interested in joining a subsidy scheme as described in the choice experiment. The estimated 'entrance value' of 104 Euros/ha/year constitutes 77% of the payments presently offered to Danish farmers for implementing buffer zones along streams and lakes – hence, the estimated 'entrance value' far exceed the 20% limit as applies in the AES under the EU Common Agricultural Policy. This is, to our knowledge, the first attempt to quantify the entrance value that seems to be needed to overcome non-economic barriers. Note however, that the large heterogeneity across farmers complicates the interpretation of ASC as a common entrance value.

We tested for heterogeneity in mean with respect to farm size (whether farms with more than 200 hectares which involves 21 % of the sample behaved differently) and earlier participation (whether farmers who participated in an AES in 2009 behaved differently than those who had not – involving 9 % of the sample).´. No systematic relations were found.

4. Discussion and conclusion

Our findings concerning farmers' perceptions of subsidy schemes help to understand some of the barriers that need to be overcome in order to increase their interest in subsidy schemes. First, our results suggest that one third of the Danish farmers did not find subsidy schemes an easy source of income. This matches the findings in Mettepenningen et al. (2009) p. 659, where 67 % of the respondents stated that the total costs incurred by AES exceeded the compensation payment. Second, there is a great deal of uncertainty among farmers about the consequences of enrolling in subsidy schemes with respect to the degree of overlap with other subsidy schemes, to what extent cross compliance will be used and there is a considerable lack of trust in authorities. These are fundamental barriers for increasing farmers' interest in AES and they need to be addressed if further uptake is to be expected.

We used the value that farmers place on obtaining assistance free of charge from the extension service to approximate their perceived costs of the administrative burden related to the application procedure. The results are promising in the sense that farmers attached a positive value to be released from the administrative burden and increasing the communication between farmers and the extension service might even be a way to reduce some of the above mentioned barriers related to uncertainty among farmers about the consequences of enrolling in subsidy schemes. Alternatively, uncertainty about the economic consequences of committing oneself to a subsidy scheme could be reduced by letting the payment size follow the development of relative in-and output prices. In that way, price uncertainty would be carried by the authorities rather than the farmers.

In the current agricultural policy, most AES are part of the cross compliance system which means that not fulfilling the requirements in the voluntary agreement can be very costly for the farmer. This suggests that farmers' reluctance to joining subsidy schemes are not directly related to the payments of the subsidy scheme in question but to their overall direct payments. The risk of being caught in a cross compliance control seems to be a real barrier which needs to be addressed if AES are to be used in future environmental policy instruments. On one side, cross compliance increases farmers' incentives for complying once they have committed to a subsidy scheme but it also reduces farmers desire to join subsidy schemes.

The choice experiment indicated that farmers are indeed able to rank individual requirements in a subsidy scheme and to trade off requirements against the amount of subsidy. From a policy point of view, these results are promising as they suggest that farmers might be made interested in implementing buffer zones by offering them something other than simply higher payments. Note that these results apply for 86% of the farmers in the sample. The remaining 14 % of the farmers consistently choose none of these which clearly indicates that these farmers will be very difficult to motivate to enrol in subsidy schemes.

Generally, we found that flexibility is the keyword for catching farmers' interest in subsidy scheme which supports findings by Wynn et al. (2001) and are also found recently in Ruto & Garrod (2009). More specifically, we found that overall flexibility of the contract (contract length and ability to cancel the contract) seemed to be more important than the actual practical restrictions in flexibility that the contracts induced (whether fertilizer could be used in the buffer zone, buffer zone width and practical assistance in the application process).

Due to the case-oriented approach, the robustness of these interpretations needs to be addressed. For example, the results indicate that when contract length varies between 1 and 5 years, then it is more valuable to sign up for short-termed contracts than for long-termed. Whether similar result holds when comparing 1 and 2 year contracts or 10 and 20 year contracts in this particular case requires further analyses but earlier findings confirm that shorter contracts are generally preferred to longer. Also further studies including other characteristics such as to what extent farmers' understanding of the precise environmental purpose of the AES would provide valuable input to future policy design just as more knowledge concerning the heterogeneity in farmer preferences for various combinations of requirements.

Regardless 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 provided that the environmental goals and environmental budgets are met. Looking at compulsory buffer zones (or other requirements), the success in terms of compliance (and necessary payments) depends greatly on designing the requirements such that the alternative costs to the farmers are as small as possible – this will also reduce the need for monitoring and control.

In the choice experiment we focused on how farmers valued the agreements. However, in order to evaluate the efficiency of agreements, we need also to assess the impacts on the environment. We found that farmers attached different costs to the requirements - but the environmental effects do 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 larger 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 for enrolling in a 5 year contracts compared to 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 subject for further research – but the contribution of the choice experiment method is that it is meaningful to ask the question – and eventually, answer it too.

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Appendix

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

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

Figure 1: An example of a choice set

	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

Which of the subsidy schemes do you prefer?

□ Subsidy scheme A
□ Subsidy scheme B
□ None of these