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Using Choice Experiments to Investigate the Policy Relevance of Heterogeneity in Farmer Agri-Environmental Contract Preferences

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Abstract Agri-environmental contracts are used to provide incentives for nature management on private land in, e.g. the European Union. The aim of this article is to investigate preference heterogeneity for agri-environmental contracts among farmers in order to discuss potential policy improvements utilising heterogeneity. We used a choice experiment to elicit farmers' stated preferences for afforestation contracts. Four attributes are investigated: purpose of afforestation, option of cancelling the contract, monitoring, and compensation level. All attributes present a potential conflict between farmers' and authorities' interests, which emphasises the importance of knowing how to handle these interests. A random parameter logit model shows that having the option to cancel the contract decreases farmers' required compensation level and monitoring increases it. Furthermore, farmers are willing to accept a lower compensation when the aim is to protect biodiversity and ground water relative to recreation. Latent class models with class probability variables reveal discrete heterogeneity and support a division into four groups with divergent preferences. For example, a group of farmers who already have forest areas does not find the option of cancelling the contract important, whereas another group relying on the farm for income requires higher compensation. The findings indicate potential for efficiency gains from targeting the contracts.

Keywords Afforestation · Contract preferences · Latent class · Participation · RPL · Regulation · Compensation

Abbreviations

ASC	Alternative specific constant
CE	Choice experiment
LC	Latent class
MRS	Marginal rate of substitution

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RPL Random parameter logit
RP Revealed preferences
SP Stated preferences
WTA Willingness to accept

1 Introduction

Agri-environmental contracts are widely used as means to provide incentives for nature management and public procurement on private land. However, in practice the design and development of contracts is often dominated by a process of 'muddling through' (Lindblom 1959). New agricultural contracts "are often rather naive…[and]…undergo numerous improvements over time" (Bogetoft and Olsen 2002: 186, 202). This is opposed to informed decision-making based on scientific investigation of farmers' decision behaviour. Attempts to improve agri-environmental contracts have focused on reducing costs from the authorities' (principals') perspective by use of more efficient allocation mechanisms, e.g. auctions (Latacz-Lohmann and Van der Hamsvoort 1997; Latacz-Lohmann and Schilizzi 2005).

In this article we investigate the effect of specific attributes of agri-environmental contracts on preferences from the farmers' (agents') perspective based on a choice experiment (CE) study on farmers' willingness to accept afforestation contracts. The attributes we investigate are: purpose of afforestation, option of cancelling the contract, monitoring, and compensation level. Similar investigations of how to improve agri-environmental contracts have also focused on farmers' preferences but covering a different set of attributes (e.g. Wilson 1997; Horne 2006; Ruto and Garrod 2009; Espinosa-Goded et al. 2010). Previous studies have selected attributes which policy-makers can alter (Ruto and Garrod 2009), may explain participation and non-participation (Wilson and Hart 2000), are inspired by existing agri-environmental contracts (Vanslembrouck et al. 2002; Horne 2006; Espinosa-Goded et al. 2010), are theoretically inspired (Hudson and Lusk 2004) or based on previous findings (Wilson 1997). These criteria should not be neglected. However, from a regulation perspective, particularly contract attributes, which may cause a conflict between preferences of farmers and authorities, should be investigated in order to develop better contracts that simultaneously meet farmers' preferences and authorities' goals.

Although heterogeneity in contract preferences among farmers has been identified in several studies (Wilson and Hart 2000; Vanslembrouck et al. 2002; Hudson and Lusk 2004; Hackl et al. 2007; Ruto and Garrod 2009) farmers continue to be offered the same contract design in existing programmes. Hudson and Lusk (2004, 14) conclude that "…this heterogeneity could have profound impact on the efficacy of contract and public policy design." For future research Espinosa-Goded et al. (2010, 14) recommend "…to identify which farmers show negative preferences for specific attributes…" This is similar to the approach taken in this study where we investigate if contract preferences may be linked to observable variables that authorities can use to differentiate contracts. Other studies also link heterogeneity in preferences to various information criteria. However, they do not focus on variables which can be used for targeting contracts. They link preference heterogeneity to different information about the farmers: whether they are participants or non-participants (Wilson and Hart 2000; Espinosa-Goded et al. 2010), geographical differences (Wilson and Hart 2000; Espinosa-Goded et al. 2010), or characteristics of the owner and/or farm (Wilson 1997; Vanslembrouck et al. 2002; Horne 2006; Ruto and Garrod 2009).

The aim of this article is to investigate preference heterogeneity for agri-environmental contracts among farmers in order to discuss potential policy improvements. The investigation is based on a stated preference study (CE) of Danish farmers' preferences for afforestation contracts. Although widely used for valuation, few studies have applied a CE to investigate landowners' contract preferences (e.g. Hudson and Lusk 2004; Horne 2006; Ruto and Garrod 2009; Espinosa-Goded et al. 2010). Afforestation contracts are selected as a case and example of a specific group of agri-environmental contracts, which in a Danish context have not succeeded in achieving the political goal, i.e. providing the desired level of afforestation.

The attributes we investigate are: purpose of afforestation (biodiversity, ground water quality, or recreation), option of cancelling the contract, monitoring, and compensation level. The four attributes share the characteristic that they may cause a conflict due to differences in authorities' and farmers' interests and thus preferred contracts. Furthermore, no other studies investigating landowners' trade-off between attributes in contracts focus on monitoring or diverging purposes of contracts (Hudson and Lusk 2004; Horne 2006; Ruto and Garrod 2009; Espinosa-Goded et al. 2010).

The analyses showed that all attributes significantly affected farmers' acceptance of the contract. Having the option of cancelling the contract created the largest drop in willingness to accept (WTA), whereas increasing levels of monitoring led to increases in WTA. Farmers were willing to accept a lower compensation level when the purpose was to protect biodiversity and ground water relative to promoting recreation. Latent class analysis suggests that our respondent sample can be placed into four distinct groups based on their elicited preferences. All groups required extra compensation for monitoring. With respect to the option of cancelling the contract, only farmers who already had forest areas, did not find this aspect important. Farmers relying heavily on the farm for income required higher levels of compensation compared with the average.

The article is organised as follows: Section 2 introduces mechanisms and issues in public procurement, theory concerning the CE method, and the applied econometric models. Section 3 presents details on survey design and data collection. Section 4 presents results from the random parameter logit model and latent class model. Section 5 discusses heterogeneity in contract preferences and potential implications for policy, and Sect. 6 presents the conclusions.

2 Theory and Methods

2.1 Public Procurement: Mechanisms and Issues in Public Procurement

2.1.1 Mechanisms

Public procurement has been used to provide public goods and environmental benefits in order to secure an adequate supply that would not be provided through traditional market mechanisms. In recent years the scope for securing such benefits has widened to include, e.g. payment for environmental services, where the provider may not be a state institution. Public procurement may also be achieved through various allocation mechanisms, such as fixed-rate subsidies, competitive bidding and negotiation (Latacz-Lohmann and Van der Hamsvoort 1997; Latacz-Lohmann and Schilizzi 2005; Baylis et al. 2008). In this article we focus on the effect of specific attributes in conditional agri-environmental contracts, but the gained knowledge may also be useful when providing agri-environmental services through other types of mechanisms.

Public procurement has to a great extent made use of fixed-rate payments, e.g. agri-environmental contracts in the European Union (Hanley et al. 1999). However, other market-based mechanisms exist, which aim to increase efficiency of contracts by either minimising costs or maximising gains by reducing information rents. A competitive bidding mechanism like auctions has since 1986 been used for allocating payments in the Conservation Reserve Program by the U.S. Department of Agriculture, and theory on auctions as a public procurement mechanism for environmental benefits has been developed (Latacz-Lohmann and Van der Hamsvoort 1997, 1998; Latacz-Lohmann and Schilizzi 2005). Theory has also been developed as to how targeting mechanisms may create efficiency gains and to what extent differentiated contracts can minimise information asymmetries (Hart and Latacz-Lohmann 2005; Alix-Garcia et al. 2008). Targeting is dealt with in this study by linking contract preferences to variables that can be used to differentiate contracts, and this creates the possibility of offering diverging contracts to different farmers. Most studies in this field deal with improving the cost and benefit sides of contracts from the principal's point of view, whereas we aim to investigate contracts from the agents' point of view. This approach may also be beneficial to the principal since it may minimise costs.

2.1.2 Issues in Public Procurement

This study investigates four different public procurement issues that may cause a conflict between interests of society/authorities and farmers. All issues represent a key discussion in public procurement. The first issue is that agri-environmental contracts serve different **purposes**. Hanley et al. (1999) operate with the following benefit categories: wildlife effects, landscape effects, water quality, archaeological sites, and enhanced access. We investigate similar benefit categories, namely enhancing biodiversity, protecting ground water quality, or creating possibilities for recreation. In public procurement this is an example of divergent interests among principal and agent, as these goals of society may conflict with the farmers' plans for the area. Previous studies either investigate one purpose such as biodiversity (Horne 2006) or contracts in general (Wilson 1997; Hudson and Lusk 2004) or compare two contracts (Vanslembrouck et al. 2002). However, to our knowledge no one has investigated the effect of different purposes as a within-contract characteristic, which makes it possible to compare preferences for the different purposes. Schenk et al. (2007, 74) investigate aims in general and find that "Several interviewees think that nature conservation should mainly serve humans", whereas some accept non-human purposes. An English study investigates recreational access in relation to financial incentive contracts and finds that two-thirds of the landowners do not have problems with recreational access, the major problems being "illegal vehicular access, visitors in non-access areas, litter and vandalism" (Church and Ravenscroft 2008: 10). Based on interviews with 20 private woodland owners in England, Urquhart et al. (2010) find that the majority, consisting of traditional and new woodland owners, are reluctant to increase public access to their land, whereas community and farmer woodland owners are willing to provide public amenity. New and farmer woodland owners are more willing to provide conservation than other owners.

The second issue is the duration of the agri-environmental contract, or the option of **cancelling the contract**. Long-term commitment is often preferable in environmental protection and nature conservation due to the gradual enhancement of biodiversity and development of habitats. The option of cancelling can be considered a flexible feature of the contract in line with keeping a set of real options that would be forgone in a permanent contract. Previous studies find a positive effect of flexibility on the willingness to participate (e.g. Wilson and Hart 2000). From the farmer's perspective, the decision to enter into an agri-environmental contract may be connected with uncertainty regarding the future costs and benefits as well as uncertainty about the opportunity costs. In the afforestation context, uncertainties are expected to be tied to an expected loss of future real options, and a lack of knowledge about the future costs and benefits related to forestry. A farmer may view the decision to afforest land as one that implies the loss of options (Thorsen 1999). If the contract is permanent, the farmer definitively loses his set of future land use options. Wilson (1997) finds that only 2% of non-participants mention duration as the reason, and that it is not important to participants. However, both Hudson and Lusk (2004) and Horne (2006) find a preference for short-term contracts and ability to cancel contracts.

The third issue is related to asymmetric information, particularly the problem of overcoming moral hazard by introducing **monitoring** (Hart and Latacz-Lohmann 2005). Moral hazard is the problem of asymmetric information with respect to the agent's (farmer's) effort (Macho-Stadler and Pérez-Castrillo 2001; Bolton and Dewatripont 2005). This problem has received attention as the trade-off between monitoring and compliance in agri-environmental contracts (e.g., Hart and Latacz-Lohmann 2005; Ozanne and White 2008). Monitoring is widely applied in agri-environmental contracts to secure compliance. Monitoring has been studied in relation to the adverse effect it may have on individuals' intrinsic motivations for exerting effort if it is perceived as controlling by the individual (Frey and Jegen 2005). Although monitoring is generally believed to have a negative impact on farmers' utility, the effect of monitoring on WTA in agri-environmental contracts has to our knowledge not been investigated before. Disutility of monitoring may be due to risk aversion and personal disutility of being monitored (Frey 1993).

The fourth issue is that authorities experience a trade-off between paying enough to make farmers participate and still use the **compensation** as efficiently as possible. Compensation or financial incentives can be understood in different ways, e.g. as a means to secure income (Wilson and Hart 2000), maximise profit, or minimise risk (Siebert et al. 2006). Furthermore, compensation is important due to budget constraints. Church and Ravenscroft (2008) find that finance was the most important incentive to provide recreational access, even though a group of landowners did not respond to it. Wilson (1997) finds a strong relationship between the participation decision and payment, where low payment was a reason for non-participation, but for others financial reasons were the main motivation to participate. A review of farmers' participation in biodiversity policies shows that "economic interests are important, but not the only, determining factor for farmers' decision making" (Siebert et al. 2006: 333). Similarly, Schenk et al. (2007) find that economic incentives are not enough to ensure participation since farmers in some cases want to remain independent.

There are other issues in public procurement that may represent a potential conflict between farmers and authorities. From a theoretical perspective, how to handle risk, transaction cost, and asymmetric information (Bogetoft and Olsen 2002; Hudson and Lusk 2004) are relevant issues. Although our CE was not designed to directly address these issues, it nevertheless provides some valuable insight. From an empirical perspective other issues such as. the amount of land enrolled, flexibility of undertaking measures, or who is the initiator of contract, have previously proved relevant (Horne 2006; Ruto and Garrod 2009; Espinosa-Goded et al. 2010) but have so far only to a minor extent been investigated in public procurement research.

2.2 Investigating Preferences

The design of agri-environmental contracts affects farmers' decisions to participate. The applied literature on agri-environmental contracts and choice behaviour makes use of various methods to investigate this. A group of methods rely on economic theory of consumer choice and non-market valuation, the two major approaches being stated preference (SP) and revealed preference (RP) methods. RP methods are based on individuals' choices made in real markets, whereas SP methods are based on individuals' choices in hypothetical situations. RP methods have the advantage that they reflect actual choice behaviour as opposed to stated choices. However, they also limit the data collection to goods (and related characteristics) which are marketed, or where market experiments can be made. Auctions have been used as a method to create markets and thereby RP data. Groth (2009) investigates auctions as a mechanism for cost-effective biodiversity conservation on private agricultural land, but does not investigate farmers' preferences for specific contract attributes. The disadvantages of using RP based on auctions are that data gathering is often time consuming and relatively expensive since actual payments must be made in order to simulate a real market. In this study we wish to investigate a combination of existing and new contract attributes, and thus data cannot be gathered from existing transactions, and an auction was not possible. Based on this, we use a CE study which is an SP method.

The CE method makes it possible to combine qualitative and quantitative attributes, which is useful in this context where compensation is combined with, among other things, different purposes of afforestation. The CE method has previously been used to investigate farmers' or forest owners' contract preferences (Hudson and Lusk 2004; Horne 2006; Ruto and Garrod 2009; Espinosa-Goded et al. 2010) and is widely applied in valuation studies (Boxall et al. 1996; Adamowicz et al. 1997, 1998a; Hanley et al. 1998, 2002; Biénabe and Hearne 2006). Horne (2006) investigates Finnish forest owners' acceptance of economic incentives for biodiversity conservation. She focuses on forest owners and established forests, and investigates a set of attributes (e.g. who initiates the contact) related to the decision to enter into a contractual relationship. Ruto and Garrod (2009) and Espinosa-Goded et al. (2010) investigate farmers' agri-environmental contract preferences using a CE. However, they focus on other attributes than this study, e.g. flexibility over areas, and what size of area to enter into the contract. Hudson and Lusk (2004) use contract theory in combination with CE to reveal agricultural producers' contract preferences. Unlike this study, they use a general contract. To make the choices realistic, it is important to simulate a real situation (Adamowicz et al. 1998b). Due to this, afforestation contracts are used in this investigation as an example of a common group of agri-environmental contracts. Farmers are expected to have great knowledge of trade-offs from past experience with agri-environmental contracts. Thus, the problem mentioned in SP studies of making respondents value unfamiliar goods is small in this context.

2.3 The Choice Experiment Method and the Econometric Model

The CE method is based on Lancaster (1966) theory that the utility of a good is derived from its attributes; the value of a good therefore consists of the sum of the value of all its attributes. In CE this is combined with the random utility theory (McFadden 1973) where an individual i's utility, U, of a good j is assumed to consist of a deterministic and a stochastic element:

$$U_{ij} = V_{ij}(x_j, z_i, t) + e_{ij} \tag{1}$$

where V depends on the characteristics of the good x_j, individual specific characteristics, z_i, and the price t. e_{ij} is a random error term that is iid extreme value type 1 and consists of factors affecting the choice but are not observable to the researcher (Louviere et al. 2000). The theory states that an individual will choose an alternative k from a finite set of alternatives

C, given the indirect utility of k is greater than the indirect utility of any other alternative, j. This means that

$$U_{ik} > U_{ij} \Rightarrow V_{ik} + e_{ik} > V_{ij} + e_{ij} \quad \forall j \neq k;\ j, k \in C \tag{2}$$

The probability that an individual chooses alternative k is the same as the probability that the utility of alternative k is greater than the utility of any other alternative of the choice set (Adamowicz et al. 1998a,b). In this case, the utility definition of the choice-task among three alternatives, one of which is the status quo option, is

$$U_{kin} = \begin{cases} V(\text{ASC}, x_{kin}, \beta_i, \varepsilon_i) + e_{kin}, & \text{if } k = 1; \\ V(\text{ASC}, x_{kin}, \beta_i, \varepsilon_i) + e_{kin}, & \text{if } k = 2; \\ e_{kin}, & \text{if } k = \text{status quo}; \end{cases} \tag{3}$$

where i denotes the individual, k the alternative, and n the choice-occasion. V_{kin}, the indirect utility, is a function of a vector of variables explaining choice x_{kin} and chosen vectors of individual-specific parameters, β_i. β_i is assumed to take on a multivariate normal distribution where the off-diagonal elements of the covariance matrix are zero. ε_i is an error component associated with the two non-status quo choices and is assumed to be normally distributed white noise, $\varepsilon_i \sim N(0, \sigma^2)$. This error component reflects that there may be additional variance related to the two non-status quo alternatives, because it is cognitively more demanding for respondents to evaluate two complex alternatives in each choice set as opposed to the status quo (Ferrini and Scarpa 2007; Greene and Hensher 2007; Scarpa et al. 2007, 2008). Lastly, e_{kin}, is a random error term that is iid extreme value type 1.

In order to calculate the choice probability for a given choice-occasion n, we use a random parameter logit model (RPL) and assume that individuals seek to maximise utility. Conditional on the individual-specific parameters, β_i, and error components, ε_i, the probability that respondent i chooses a specific alternative k in choice-task n (of the sequence $n = 1, \ldots, N$) from the three alternatives ($j = 1, \ldots, J$) is logit:

$$\Pr(kin|\beta_i, \varepsilon_i) = \frac{\exp\left(\beta_i' x_{kin} + \varepsilon_i\right)}{\sum_j^J \exp\left(\beta_i' x_{jin} + \varepsilon_i\right)} \tag{4}$$

If we assume independence over choice-tasks made by the same individual, the joint probability of an individual making a sequence of choices is the product of the, in our case, six probabilities. The probability of choice unconditional on the error component is obtained by integrating over the error-component space. Following this, the marginal probability of choice can be derived from integrating over the distribution functions for the random $\beta\_$ parameters (Scarpa et al. 2008; Train 2009). Following the above, the probability of choosing alternative k becomes:

$$\Pr(kin) = \int \left(\prod_{n=1}^{N} \left[\frac{\exp\left(\beta_i' x_{kin} + \varepsilon_i\right)}{\sum_j^J \exp\left(\beta_i' x_{jin} + \varepsilon_i\right)} \right] \right) f(\beta) d\beta \tag{5}$$

where $f(\beta)$ is the distribution function for β, with mean b and covariance W. The model is not sensitive to the independence of irrelevant alternatives (IIA) condition and, furthermore, it allows for individual-specific β estimates based on specified distributions (Train 1998). This means that the model utilises the information that each respondent has answered several choice sets, by making taste parameters constant over choices within individuals but not between individuals. Including this information is likely to enhance the explanatory power of the model.

In addition, we estimate a LC model. Although socioeconomic characteristics can also be included in the RPL model, the LC model is believed to be able to provide a different dimension for describing the present data, where farmers are expected to have different motivations and aims for their respective land management, and therefore potentially belong to discrete groups based on their preferences and latent variables (psychometric constructs). Like RPL, LC models relax the assumption of homogeneity from a conditional logit model, but where RPL accounts for heterogeneity in the estimation, LC accounts for it by creating classes. Thus, LC is less advanced, but on the other hand more suitable for explaining the reasons for heterogeneity.

The LC model can be seen as a discrete form of the mixing distribution, where β with probability s_m takes on the value $b_m, m = 1, \ldots, M$ and $f(\beta) = s_m$ for $\beta = b_m$, and the choice probabilities can be written as (cf. Train 2009):

$$\Pr(kin) = \sum_{m=1}^{M} s_m \prod_{n=1}^{N} \left(\frac{\exp(b'_m x_{k_n in})}{\sum_j^J \exp(b'_m x_{jin})} \right) \tag{6}$$

s_m is thus the probability of membership of segment m and can be written as:

$$s_m = \frac{\exp(\lambda_s Z_i)}{\sum_{s=1}^{S} \exp(\lambda_s Z_i)} \tag{7}$$

where Z_i is a vector of psychometric constructs and socioeconomic characteristics, and λ is a vector of parameters (Boxall and Adamowicz 2002). The LC model mixes characteristics of the individual, in form of, e.g., measureable terms such as some socioeconomic characteristics, and less measurable terms such as psychometric constructs, with the stated behaviour in the choice sets. We focus on characteristics that may be usable in contracts, which implies that they must be objectively measurable, e.g. size of farm and ownership of forest. Like for RPL, the assumption of independence of irrelevant alternatives is not needed because the choice probability depends on the utility of other alternatives also.

3 Survey Design and Data Collection

3.1 Data Collection: Online Questionnaire to Farmers

The data were collected using an online, e-mail distributed questionnaire among Danish farmers in January and February 2009.[1] SurveyXact was used as software. The questionnaire was discussed with a focus group consisting of farmers and experts, which resulted in some redesign. Before the final distribution of the questionnaire, a pilot test with 61 farmers was conducted.

Eighteen out of 46 local Danish Agriculture associations agreed to distribute the questionnaire to their members as a link in an e-mail. The e-mail encouraged the farmer to answer the questionnaire by giving the opportunity to win a prize of 3 times €135 and addressed possible concerns regarding the questionnaire, e.g. that answers would be kept confidential. The questionnaire was distributed to a total of 3,609 farmers and 1,027 farmers answered, equalling a response rate of 28.5%. Respondents who answered less than four questions are not included in the sample.

[1] An English version of the questionnaire can be acquired by sending an e-mail to the authors.

3.2 Survey Design: Choice Experiment Attributes and Details of Questionnaire

The questionnaire first presented questions regarding the property, followed by questions about afforestation, agri-environmental contracts in general, and potential direct use values derived from forests. Next came the CE, follow-up questions on the CE, and finally questions about the characteristics of the farmer.

For the CE, four attributes were selected in order to investigate the four theoretical issues in public procurement (see Sect. 2.1). The attributes are shown in Table 1. The decision on the number of attributes rests on a trade-off between simulating actual choices and choice contexts (Adamowicz et al. 1998b) and making the choices manageable for participants (Swait and Adamowicz 2001). Previous uses of CE to investigate contract preferences have in some cases comprised five or six attributes (Hudson and Lusk 2004; Horne 2006). In addition to the theoretical reasoning (see Sect. 2.1), the attribute selection is based on findings from previous studies of landowners' contract preferences (e.g. Wilson 1997; Hudson and Lusk 2004; Horne 2006), discussion with experts including agriculture and forestry consultants and researchers, and a focus group with Danish farmers. The four attributes share the characteristic that they may cause a conflict between authorities and farmers due to differences in perspectives on good contracts.

Furthermore, the attributes, and particularly the level of each, are selected with reference to the current design of agri-environmental contracts in the Danish afforestation programme. For example, the selected levels of the purposes of contract are both in line with the programme focus (The Danish Forest and Nature Agency 2002, 2009) and agri-environmental contracts in general (Hanley et al. 1999). The levels of monitoring are both above and below the current level of 5% (i.e. 5% of all contracts are monitored during the contract period), which is a requirement from the European Union (Jørgensen 2009). With respect to the option of cancelling the contract, there is a difference between agri-environmental contracts in general and

Table 1 Attributes investigated in choice experiment

Attribute	Description (name of corresponding variable)	Levels
Purpose of afforestation	Biodiversity implies that the afforested area mainly consists of broadleaved trees (biodiversity)	Biodiversity
	Ground water protection implies that the ground preparation is minimal and no pesticides/herbicides can be used (ground water)	Ground water protection
	Recreation implies that there has to be established walking paths and parking areas (recreation—reference)	Recreation
Option of cancelling the contract	The contract is either permanent or may be cancelled within 5 (Cancel 5) or 10 years (Cancel 10). If the contract is cancelled, the subsidy has to be paid back to the state (with a specified interest rate) and the landowner is then free to return the area to arable land	Option of cancelling within 10 years Option of cancelling within 5 years
	A permanent contract means that the area will be forest reserve in perpetuity (permanent—reference)	Permanent contract
Monitoring	A fraction of the landowners who accept a contract will receive a visit by the authorities in order to check landowners' commitment (monitoring, 0% is reference)	1% will be monitored 10% will be monitored 25% will be monitored
Compensation	The compensation is the amount of Euro the landowner receives as a one-time payment per ha (compensation)	€3,600–5,600 per ha (in steps of €400)

Danish afforestation contracts. According to the Forest Act (Danish statute), once afforested an area in Denmark has to remain forest, and therefore this study focuses on the option of cancelling the contract within a number of years, where other studies investigate length of the contract (Horne 2006; Ruto and Garrod 2009). Compensation levels are selected both above and below the stated costs of afforestation presented in the CE, which allows us to investigate if farmers are willing to bear some of the costs.

The CE was introduced with information about the attributes and the level of each. The compensation levels were not mentioned, since it might result in anchoring at the highest offer. Each choice set was introduced with a scenario. It was kept short to minimise the risk of framing the choice as positive or negative, but still made the respondents able to choose. The respondent was asked to imagine having 1 ha of land giving a net income of €135–270 per year that could be afforested at €4,030 regardless of the purpose of the afforestation. Additional costs related to different contract offers were assumed covered. Each choice set consisted of two alternative contracts and an option to decline both contracts (status quo), see "Appendix".

The total number of possible combinations of the attribute levels was $3^3 \times 6 = 162$. A balanced design consisting of 36 choice sets was made using SAS, where attribute levels were allocated to alternatives according to a D-efficient fractional factorial design identifying all main effects and two-way interactions. The 36 choice sets were divided into 6 blocks and the respondents were randomly distributed to one of these blocks. To separate choice sets into blocks is a usual way to handle the trade-off between maximising the use of each respondent without resulting in learning or fatigue among respondents (Adamowicz et al. 1998b). The statistical efficiency of the design at the generation stage was estimated in NGene 1.0.2 and the D-error was 0.04927 (assuming a MNL model with zero priors, dummy coded variables (purpose of afforestation, option of cancelling the contract) and linear utility functions).

3.2.1 Representativeness

The response rate of 28.5% may cause non-response bias relative to the entire population of Danish farmers. We cannot attest that our sample is representative of the population of Danish farmers. However, the aim of the study is to investigate the preferences of farmers who are interested in forming contracts for providing agri-environmental services, and it is sensible to believe that respondents are likely to fall into this group. There may be bias in the sample since farmers, who are not members of a farmers association, are excluded from participating, as are farmers without internet access. However, approximately 90% of all Danish farmers are organised through local farmers associations and 85% of the population have internet access at home (Statistics Denmark 2008). This is expected to reduce the risk of demographic difference that may exist between respondents from online and postal questionnaires (McDonald and Adam 2003; Umbach 2004). Due to the distribution method, statistics for non-respondents cannot be made. Instead we compare the sample with the population. With regard to age, there is no significant difference between the sample and the population of Danish farmers (χ^2 test, $p = 0.332$). There is some overrepresentation of large farms and underrepresentation of small farms. However, all farm sizes are represented.

3.2.2 Initial Data Screening

The full sample consists of 1,027 respondents, but 174 were excluded, either for not having answered any of the choice sets (146), for answering status quo in the first choice and nothing else in the rest (25), or for stating that they did not consider and/or understand the six questions (3). The remaining group used for analysis constitutes 853 respondents who have answered 5053 choice sets, as not all respondents completed all six sets.

3.2.3 Model Specifications

The purpose of the contract and the option of cancelling were dummy coded, and the excluded levels, which are tied to the alternative specific constant (ASC), are 'recreation' and 'permanent contract'. The monitoring attribute was included as a linear variable reflecting the levels from 1 to 25%. The, ASC defines a situation with 0% monitoring, recreation as purpose of the contract, and the contract is permanent. The compensation parameter has been divided by 10,000 to make the model converge more easily. The RPL model was estimated using 1,000 Halton draws. In the RPL model, the coefficients on the ground water and biodiversity variables, both cancelling options and monitoring, are each given an independent normal distribution with mean and standard deviation that are estimated.

The normal distribution is assumed as we cannot rule out in advance that respondents' preferences may to some extent cover both positive and negative parameter values.

4 Results

4.1 RPL Model

All parameters for contract attributes are significant in the RPL model, see Table 2. For the entire sample, the explanatory power of the model is high (McFadden Pseudo-$R^2 = 0.368$) (see Hensher et al. 2005: 337–339). The standard deviations in Table 2 show that there is heterogeneity among respondents around the mean. Although the mean parameter estimates for ground water, biodiversity, and monitoring are significantly different from zero for the entire

Table 2 RPL model of contract preferences

	Coefficient (SE)	Standard deviation (SE)	Probability of negative coefficient (%)
Constant (ASC[a])	−5.095 (0.361)	–	
Groundwater	0.477 (0.094)	1.369 (0.140)	37
Biodiversity	0.860 (0.103)	1.652 (0.139)	30
Cancel 5	1.128 (0.089)	0.726 (0.161)	5
Cancel 10	1.181 (0.093)	0.890 (0.145)	9
Monitoring	−0.031 (0.004)	0.046 (0.006)	75
Compensation	1.090 (0.070)	–	
ε_i	6.046 (0.363)		
No. of choices	5,053		
Log likelihood/restricted log likelihood	−3,508/−5,551		
McFadden pseudo-R^2	0.368		
No. of parameters/χ^2	13/4,087		

All parameter estimates significant at $p = 0.001$ level

[a] ASC is an alternative specific constant taking the value 1 if one of the scenarios is chosen and zero otherwise

Table 3 Marginal rate of substitution[a] RPL results (Euro)[b]

	MRS (SE)
Constant (ASC)	6,280 (311)
Ground water	−587 (120)
Biodiversity	−1,060 (134)
Cancel 5	−1,390 (116)
Cancel 10	−1,455 (127)
Monitoring	38 (5)

All values significant at $p = 0.001$
[a] Estimated by the Delta method
[b] DKK are converted to Euro using €1 equals DKK 7.44

sample, there is large variation within preferences, and the standard deviations for especially these three attributes are quite high and show that for at least some of the respondents the parameter estimates are likely to be negative. For example, for biodiversity approximately 30% of the population is indicated to have a negative parameter estimate, whereas for cancelling the contract within 5 years it is only the case for approximately 5%. This implies that these percentages of respondents would require additional compensation for biodiversity measures and for having the option to cancel the contract. Furthermore, the error component associated with choosing one of the two contracts, as opposed to choosing status quo, is captured by the significant parameter estimate for ε_i. This means that the cognitive burden and the uncertainty related to the choices are higher when respondents choose one of the two contracts as opposed to choosing status quo.

Table 3 shows the mean marginal rate of substitution (MRS) for the population, calculated based on parameter estimates from Table 2. The results show that the option of cancelling the contract is the attribute with the largest MRS (approx. €1,400–1,450). There is no significant difference between the 5 and the 10 year option. Farmers prefer biodiversity, subsequently ground water, and then recreation. Monitoring increases the level of compensation needed to make the farmers accept the contract with almost €40 per 1% increase in monitoring.

4.2 Latent Class Model

In order to explore if the heterogeneity in respondents' preferences may reflect systematic variation and be ascribed to groupings among respondents, the entire sample is analysed using an LC model (by using Nlogit 4.0, 2007). Table 4 compares model statistics for latent class models with two to five classes and RPL. We selected the model with four classes even though most of the information criteria support a model with five classes—except for BIC which supports a model with four classes. However, the change in AIC is smaller from four to five classes than from three to four classes, indicating that adding the fifth segment probably does not improve the model markedly (Boxall and Adamowicz 2002). AIC may have a tendency to point towards too high a number of preference classes, whereas BIC does not (McLachlan and Peel 2000; Scarpa et al. 2007). One group in the model with five classes constitutes only 3% of the respondents and has an insignificant parameter estimate for compensation, further supporting a four class model (see Scarpa and Thiene 2005 for a similar argument).

Table 4 Criteria for selecting number of latent classes

Number of classes	Log likelihood	Info. criterion: AIC	Finite sample: AIC	BIC	HQIC	McFadden pseudo R^2
RPL	−3,508	1.3935	1.3935	1.4103	1.3994	0.3681
2	−3,682	1.4645	1.4645	1.4877	1.4726	0.3367
3	−3,604	1.4379	1.4380	1.4753	1.4510	0.3508
4	−3,503	1.4025	1.4026	**1.4541**	1.4206	0.3689
5	−3,465	**1.3918**	**1.3920**	1.4577	**1.4149**	0.3757

Table 5 shows the results from the latent class model with four classes, and Table 6 shows the mean MRS calculated based on these coefficients. In groups 1, 2 and 3 all significant attributes have the same sign as in the RPL model. **Group 1** is the largest group with respondents, having a probability of 36% of belonging to this group. Here it is more expensive to compensate respondents compared with the findings in the RPL. They require the highest compensation for the reference scenario (ASC approx. €9,000), see Table 6. They show less willingness to reduce compensation by substituting any of the attributes with other levels compared with the other groups, as all MRS are smaller and/or insignificant. Moreover, they do not show any preferences for ground water compared with recreation. The coefficients for ASC and compensation are both significant at the 1‰ level, whereas the coefficients for biodiversity and the option to cancel within 10 years are significant at the 5% level. The respondents in **Group 2** have significant parameter estimates for ground water, biodiversity, monitoring, and compensation which all are significant at the 1‰ level. This group stands out as the only group with a non-significant parameter estimate for ASC and for both options of cancelling. Respondents in group 2 have the highest MRS for biodiversity relative to all other groups. Respondents in **Group 3** show significant preferences for all attributes at the 1‰ level. This group has the second highest ASC (approx. €7,300). However, as opposed to group 1, respondents in this group have higher MRS for ground water, biodiversity, and the option of cancelling. Therefore, they show higher WTA reductions in compensation, depending on which levels of attributes characterise the contract. **Group 4** has significant parameter estimates for all attributes but stands out as the only group where respondents require a larger compensation for biodiversity (approx. €1,500) and ground water (approx. €800) relative to recreation. Furthermore, this group has the highest MRS for the options of cancelling the contract within 5 or 10 years.

Table 5 Latent class model with four groups

Average class probability	Group 1 36.0	Group 2 20.7	Group 3 19.3	Group 4 23.9
Constant (ASC)	−10.417***	−0.475	−4.160***	−0.603*
	(−1.484)	(0.349)	(0.293)	(0.287)
Ground water	0.204	0.826***	0.871***	−0.393***
	(−0.475)	(0.074)	(0.098)	(0.088)
Biodiversity	1.062*	1.655***	1.236***	−0.757***
	(0.418)	(0.091)	(0.095)	(0.088)
Cancel 5	0.748	−0.058	0.770***	1.852***
	(0.475)	(0.088)	(0.096)	(0.097)

Table 5 continued

Average class probability	Group 1 36.0	Group 2 20.7	Group 3 19.3	Group 4 23.9
Cancel 10	0.891*	0.004	0.674***	1.985***
	(0.432)	(0.080)	(0.095)	(0.098)
Monitoring	−0.032[†]	−0.019***	−0.021***	−0.025***
	(0.018)	(0.003)	(0.004)	(0.003)
Compensation	1.554***	0.857***	0.768***	0.666***
	(0.366)	(0.079)	(0.074)	(0.069)
Class probability variables				
Constant	0.060	−0.560*	−0.507*	(Fixed)
	(0.162)	(0.234)	(0.208)	
Own forest	−0.106	0.514[†]	0.306	(Fixed)
	(0.215)	(0.287)	(0.266)	
Main income from farm	0.650**	0.366	0.287	(Fixed)
	(0.212)	(0.282)	(0.268)	
Area >200 ha	0.662[†]	−0.187	0.143	(Fixed)
	(0.359)	(0.512)	(0.447)	
No. of choices	5,053			
Iterations completed	79			
LL/Restricted LL	−3,503/−5,551			
McFadden pseudo-R^2	0.3689			
No. of parameters/χ^2	40/4,098			

Parameter estimate (standard error)
*** Significance at $1^0/_{00}$; ** 1%; * 5% level and [†] 10 % level

Table 6 Marginal rate of substitution[a] LC results (Euro)[b]

	Group 1 MRS (SE)	Group 2 MRS (SE)	Group 3 MRS (SE)	Group 4 MRS (SE)
Constant (ASC)	9,010 (1,001)***	745 (494)	7,283 (317)***	1,217 (475)*
Ground water	−176 (420)	−1,295 (161)***	−1,524 (323)***	794 (185)***
Biodiversity	−918 (440)*	−2,595 (1,786)***	−2,164 (252)***	1,528 (237)***
Cancel 5	−647 (407)	91 (138)	−1,348 (203)***	−3,735 (421)***
Cancel 10	−770 (402)[†]	−7 (125)	−1,180 (195)***	−4,004 (427)***
Monitoring	28 (18)	29 (6)***	37 (7)***	51 (9)***

*** Significance at $1^0/_{00}$; * 5 % level and [†] 10 % level
[a] Estimated by the Delta method
[b] DKK are converted to Euro using €1 equals DKK 7.44

The probability of belonging to each class was estimated by parameterising class probabilities. Only observable variables which could be used to differentiate contracts are included. The analyses show that there is no effect of the type of agricultural land use (cattle, pigs, crops, other) and of small or medium sized properties (<30, 30–200 ha). The class probability variables that proved significant are: the presence of forest on the property, main income from agricultural production, and agricultural properties larger than 200 ha, see Table 5. Of the group who has the main income from the farm, 19% has a property larger than 200 ha, implying that the groups are not completely overlapping. These variables were dummy coded based on the following characteristics: Is the forest area on the property larger than 1 ha; is the main household income based on the agricultural production; is the property larger than 200 ha. The class probability variables only tell something about group belonging, not the overall probability of choice. Table 5 shows that if the farmer has more than 1 ha of forest on the property, then there is a greater probability of belonging to class 2, but the variable is only significant at the 6.5% level. If the main income of the household comes from agricultural production, there is a greater probability of belonging to class 1 (significant at the 1% level). Furthermore, if the property is larger than 200 ha, the probability of belonging to class 1 increases again.

5 Discussion

In this article we have investigated the heterogeneity of farmers' preferences for agri-environmental contracts, exemplified by contracts for afforestation. A CE study of four attributes, which were identified as relevant for agri-environmental contracts due to a potential conflict between farmers and authorities, was applied. An in-depth understanding of farmers' contract preferences is of interest since it provides the foundation for developing and designing agri-environmental contracts, which are appealing to farmers and, through this process, ultimately reach environmental policy goals.

5.1 RPL Model: Population Pattern

The results of the RPL model show the mean population preferences. Parameter values are significant for all investigated attributes when compared with the reference scenario. Respondents express preferences for having the option of cancelling the contract within 5 or 10 years. There are generally only minor differences between having the option of cancelling within 5 or 10 years, which indicates that it is having the option that is important. Having this option leads to a willingness to reduce the compensation by approximately €1,400–1,450—the highest reduction for all the attributes investigated. This is in line with previous findings, e.g. Horne (2006) finds that 100 year contracts and contracts which cannot be cancelled by a new owner create disutility. There may be several explanations for the importance of having the option to cancel. For example, Hudson and Lusk (2004) find that a complete loss of autonomy is what creates the largest disutility. The main desire of a farmer could be to avoid choosing something that is irreversible on his property and thus keeping future (real) options for a number of years (Thorsen 1999). This is in line with Wilson (1997) who finds that severe changes negatively influence willingness to participate. The strong preference for the option to cancel may also be related to the large uncertainties farmers connect with afforestation, i.e. future benefits, management, and successful establishment. At present, farmers do not have the option of cancelling contracts in the Danish afforestation programme, and introducing this option may therefore lead to greater interest in and acceptance of afforestation contracts at a lower cost (level of compensation). Based on the value connected with forests and the cost of cancelling being high, it is not likely that farmers will often convert an area into agricultural land once it is afforested, implying that introducing the option does not necessarily conflict with the goals of society. Furthermore, in the few cases where farmers prefer to convert, it may also be the preferred solution for society due to, e.g. lack of fields for food production.

With regard to the purpose of afforestation, respondents prefer biodiversity, subsequently ground water, and lastly recreation. Respondents are willing to accept approximately €590 less in compensation if the purpose of afforestation is ground water as opposed to recreation, and €1,000 less if the purpose is biodiversity (as opposed to recreation). In this study, biodiversity as purpose only entails that the afforested area mainly consists of broadleaved species. Some farmers may regard this as the least restrictive requirement of the three purposes investigated here, and the low compensation connected with biodiversity may reflect the low level of restrictions. This is in line with Horne (2006) who finds that increasing restrictions result in increased compensation requirements. Even though we have stated what each of the three purposes of afforestation implies (e.g. broadleaved trees, parking spots, etc.) we cannot distinguish to what extent the preferences also come from predetermined attitudes towards the three purposes. Farmers are mostly negative towards recreation, which may be due to problems with littering and invasion of privacy/private property. Church and Ravenscroft (2008) find that landowners dislike recreation due to such experiences. The establishment of parking spots could also be the crucial factor. Investigations in England have shown that illegal vehicular access is among the most common reasons for having negative attitudes towards recreation (Church and Ravenscroft 2008). Urquhart et al. (2010) find the enjoyment of private ownership, and fear of visitors harming the health of woodland and wildlife, as reasons for negative attitudes towards recreation.

The investigation of the three purposes shows that policy and the design of agri-environmental contracts may benefit from focusing on specific purposes of afforestation in specific areas, since forest for recreational purposes is more expensive to the average farmer than the other investigated purposes. For example, recreation should only be established in areas where there is a demand for it; it is not worth forcing farmers to establish paths for recreation in case of no demand.

Monitoring is expected to have a negative impact on respondents' utility and therefore results in a higher WTA. This is also the result of the RPL model, where respondents on average want an increase of €38 per 1% increase in monitoring. It is well known that authorities face a decision concerning the optimal level of monitoring given the costs. In addition to the direct costs connected with monitoring, this analysis shows that authorities also have to take the costs arising from farmers' disutility of monitoring into account, when evaluating the costs and benefits of monitoring in agri-environmental contracts. For further investigations of whether the disutility relates to direct cost of monitoring or an experience of personal disutility, see Vedel et al. (2010).

5.2 Latent Class Model: Pattern of Segments

While the RPL model provides a good overview of the population mean effects of attributes, it is computationally difficult to use for analysis of patterns in heterogenic preferences. The LC analysis showed that some of the heterogeneity may be explained by groupings among respondents who to some extent share similar preferences. An LC model with four preference classes provided the best fit and explanatory powers, and showed that some groups deviated systematically from the mean values presented in the RPL model.

There is a significantly greater probability of belonging to group 1 if the main household income comes from agricultural production. This tendency is the same for respondents with properties larger than 200 ha—although less significant. It is worth noting that there is not a complete overlap between farmers having large properties and depending on the property for income—approximately 28% of farmers with properties larger than 200 ha do not have agricultural production as their primary source of income. The farmers in group 1 are characterised by being more expensive to compensate than the mean in the RPL model. Although they find biodiversity and the option of cancelling relevant, they require a relatively high compensation regardless of the presence of these two attributes. They are indifferent between ground water and recreation. The results indicate that the primary focus of farmers in this group is the agricultural interests. This may explain why it is relatively more expensive to make these farmers accept an afforestation contract. The question is if this could be explained by farmers having higher opportunity costs. However, the afforestation scenario (annual net income of €135–270) represents only low productivity land at the time when the survey was conducted. Therefore, only if farmers considered their own situation instead of the scenario would high opportunity costs be an issue. We have tested if intensive animal production (which by law requires a certain land area and hereby potential higher opportunity costs of afforestation) influences the probability of belonging to a specific group. However, this was not the case. Another interesting aspect is that group 1 stands out as the only one where monitoring is not significant. Farmers in Denmark, whose primary source of income is the agricultural production, are used to monitoring, and probably therefore they may believe that one more or less visit at the margin is not of great importance.

Respondents in group 2 are more likely to have experiences with forestry, as forest ownership increased the probability of belonging to group 2 (p value 0.065). Group 2 is characterised by farmers who, on average, do not require compensation for the reference scenario and find the options of cancelling irrelevant. This supports the discussion that the need for this option may be tied to the uncertainties farmers may have regarding the benefits and costs of having a forest area. Respondents in group 2 do not have the same uncertainty regarding the benefits and therefore the option of cancelling is not important. Furthermore, they find ground water important and biodiversity even more so, which indicates that they do not solely focus on production interests. With regard to agri-environmental policies, this result shows that it may not be necessary to offer an option to cancel if the aim is to contract with farmers who already have forest areas on their property. However, it has great importance to farmers who have to cope with large uncertainties concerning the benefits and costs of forest areas. Moreover, the results also indicate that it is cheaper to establish afforestation contracts with farmers who already have forest areas on their property. This could be relevant in a policy context of where to invest in afforestation. Should proximity to existing forest areas (which may be cheaper) be favoured, or should afforestation contracts favour regions with a low percentage forest cover, knowing that this may be more expensive if a large part of farmers has no experience with forestry?

The class probability variables did not further explain which respondents belonged to groups 3 and 4. The preferences in group 3 resemble to a great extent the mean values of the population found in the RPL model. The respondents in class 4 are, on the contrary, characterised by having higher compensation requirements for both biodiversity and ground water as opposed to recreation. They constitute the share of farmers with negative preference for these two purposes, which was shown by the high standard deviations in the RPL model. They have low compensation requirements for the reference scenario and extremely high utility gains from having the option to cancel. These farmers may require a larger compensation for biodiversity and ground water, because they fear that these purposes may lead to restrictions on their present agricultural land use (e.g. enhanced focus on protection of species and ground water, and potential preservation regulations). Another interpretation of the different preference ordering could be that the farmers live in areas where public recreational interests are unimportant and their main focus is on afforestation for private recreational purposes, e.g. improving habitats for game. Policy wise, farmers with these preferences are relatively cheap to compensate if they are given an option to cancel the contract.

5.3 Targeting: Pros and Cons

Many agri-environmental policy goals can be fulfilled if it is possible to contract with a share of farmers. In existing agri-environmental contracts farmers are normally treated as a homogeneous population; this resembles the mean values for the population found in the RPL model. However, these mean values cover systematic differences in the population of farmers.

The LC results open a discussion on the potential benefit of tailoring or targeting contracts to specific groups of farmers. Previous studies suggest increased economic efficiency from such an approach (Hart and Latacz-Lohmann 2005; Alix-Garcia et al. 2008). However, the LC results raise the question of whether the effect of farmer and farm characteristics on group probability is strong enough to make targeting beneficial. We found three significant class probability variables, but they explain only belonging to groups 1 and 2. Policy-makers may want a stronger signal of group belonging before offering tailored contracts to specific groups of landowners, as this implies higher transaction costs. However, the information revealed could improve the existing contract if used in relation to the goals of afforestation, e.g. if forest is particularly preferred in areas without forests, the option of cancelling should be introduced, as owners without forest are more expensive to compensate if they do not get the option.

Our results show that further investigation of group probabilities is worthwhile and could strengthen the scope for targeting by combining contract preferences with other types of characteristics which are available or cheap to obtain and legitimate to use for targeting. Other characteristics which could influence contract preferences are observed landscape characteristics (presence of specific habitats which have been reserved or established by the farmer), management characteristics (how the area is managed now) or soil quality (how suitable the land is for agricultural production). Qualitative studies could identify which characteristics could be relevant for further investigation, and furthermore form the basis for developing questionnaires which could link responses on contract preferences with personal data that can upon application be offered through the Danish Data Protection Agency.

5.4 Limitations etc.

A common problem in stated preference studies is overstatement of WTA. This is likely to also occur here. There could be a tendency to overstate or give strategic answers regarding, e.g. how much disutility recreation as a purpose imposes on the respondent—or how significant the option of cancelling is—in order to influence future agri-environmental contracts. An interesting discussion is whether a group of respondents are more likely to overstate or answer strategically, or if some attributes are more likely to be influenced by these two problems. For example, group 1 of "hard core" farmers are more expensive, which could be a sign that they try to answer strategically to increase compensation levels. The fact that recreation is the most expensive purpose is considered a sign of actual disutility when comparing with subjective statements as well as other studies. Respondents have shown that an option to cancel within 5 years is, for most respondents, equally attractive as an option to cancel within 10 years. So although overstating cannot be ruled out, the relative importance of attribute levels is believed to reflect true preferences. For further studies it could be interesting to include questions to improve the option of investigating strategic answers or overstating.

6 Concluding Remarks

In this article we have investigated heterogeneity of farmers' preference for agri-environmental contracts through a CE study of afforestation contracts. Four attributes, which represent a potential conflict between interests of farmers and authorities, were selected. The aim was to improve future regulation by developing and designing agri-environmental contracts that reflect farmers' preferences better, while improving overall social efficiency.

Altogether these findings show important potential for further development of afforestation contracts. Furthermore, results are likely to carry over to similar agri-environmental contracts or other goods/services, as the investigated attributes are present in other types of contracts.

Introducing an option to cancel the contract within a limited period can greatly improve farmers' acceptance of contracts at a lower cost to society—especially farmers who do not have forest on their land. Targeting could also be relevant, since the results indicated that the importance of cancelling the contract was tied to farmers' uncertainties of the future benefits and costs of establishing a forest. Contracts directed at farmers who already have forest on their property need therefore not offer an option to cancel the contract, whereas everybody else should be offered such option as a way of handling their uncertainties. The option could be introduced as a way for society to encourage the establishment of forests in new areas. It is also important to consider the additional costs of monitoring arising from the disutility farmers' experience and compare it with the benefits (i.e. compliance). Moreover, targeting with regard to the purpose of afforestation is relevant, since recreational areas are more expensive to establish than areas which protect biodiversity or ground water interests.

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Appendix: Example of a Choice Set

Imagine that you have an area of 1 ha which gives an annual net income of €135–270, and that you have a possibility of planting a forest on this area. It will cost you €4,030 in establishment cost, regardless of the purpose. The compensation is a one time payment.

Choice 1 out of 6

Which contract would you choose?
(*Mark one*)

	Contract 1	Contract 2	
Purpose of afforestation	Ground water	Recreation	
Possibility of cancelling the contract	Can be cancelled until year 10	Cannot be cancelled	
Visits by authorities[a]	10 % are visited	25 % are visited	
Compensation (DKK/ha)	4,840 €/ha	5,650 €/ha	I do not want any of the contracts
	Contract 1 ❑	Contract 2 ❑	❑

[a] In the choice sets sent to the farmers monitoring is referred to as "visits by authorities"

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