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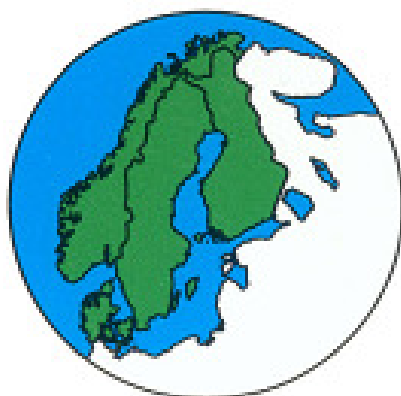
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Ås

Contract design from a landowner perspective

Working paper

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Abstract

There is a political goal in Denmark to increase the amount of forest from 12 % to 20-25 % of the land area and approximately 63 % of the land area is farmland which is mainly privately owned. Therefore, political goals with regard to afforestation cannot be satisfactorily reached on state owned areas alone and afforestation has been subsidized in Denmark since 1990. Due to private property rights and the possible conflict with public interest in nature, methods are needed to induce incentives for afforestation on private land. Contracts between the state and landowners are a common way to do this. Often monetary incentives are used as the primary way to heighten the acceptance rate of the contracts, however, little is known with regard to the effect of other attributes. This paper presents a proposal of a planned study where we would like to investigate the effects of: main purpose of the afforestation, value of the option to denounce contract, size of afforested area and timing of the compensation.

Data will be gathered through a Choice Experiment investigation (CE). The CE method is chosen since it allows us to investigate both quantitative and qualitative attributes at various levels.

Key words: Contracts, afforestation, choice experiment, attributes, landowner, contract theory, adverse selection.

Introduction

Afforestation is of increasing importance and can be related to multiple goals as ground water protection, enhancing biodiversity, carbon sink, recreational use etc. In Denmark it is a national goal to increase the forest area from approximately 12 % in 1990 to 20-25% within the next 80-100 years. This requires a yearly afforestation of 4-5,000 ha and from 1989-1998 the afforestation had been less than 1,800 ha/year (SNS, 2008a). Since 63 % of the land is farmland (Dansk Landbrug, 2007) mainly owned by private landowners a great deal of the afforestation has to take place on private land in order to reach the national goal.

Politically determined goals will, however, often be in conflict with the objectives of private landowners; e.g. the food prices at the moment

pulls toward farming instead of afforestation. In most cases it will be necessary for the state to provide private landowners with incentives to reach the political goals concerning afforestation. It is important that the goals are reached through incentive providing schemes where landowners may choose a contract on a voluntary basis since the experience of being forced through regulations is known to greatly diminish private utility and joy of ownership (Horne, 2006). In Denmark contracts are a common used method to induce incentives for nature management on private land. Only 6% of the open land is designated as a zone where afforestation is wanted, 69 % where afforestation is possible (neutral areas) and 25 % where it is not wanted (Jørgensen, 2008). The applications have the last 3-4 years been equally distributed among the positive and neutral areas which mean that the density of applicants is much larger in the positive area. There have not been applicants for the entire subsidy pool the last 3-4 years (Jørgensen, 2008)

Often, the design of schemes and contractual relations for increasing nature management on private land are based on minor adjustments in the type of scheme previously used, combined with the planner's personal perspective on how it should be designed. In a planning context this can be referred to as "muddling through" (Lindblom, 1959). More knowledge is needed concerning landowners' preferences and trade-offs between contract attributes if afforestation policies should be optimized in the future.

The aim of this study is to investigate forest owners' preferences and trade-offs between different attributes in contracts for afforestation in order to improve the contractual relationship. We would like to investigate if the aim of the afforestation has an effect on the private utility of the landowner and thereby on the required compensation. Furthermore, we investigate the value of providing the landowner with an option to denounce the contract and the effect of the timing of the compensation. The effect of the size of the afforested area will also be analyzed.

The contractual relationship can be improved from both the perspective of the planner and the landowner. The planner would like to find data which reveal new contractible background variables and she would also like to gain a better understanding of the opportunity costs and the private utility the landowner experiences when signing a contract for afforestation. Moreover, she would like to know the trade-off the landowners make between different attributes in the contract. The landowner can benefit from an improved contract design that suits the landowners preferences and trade-offs better.

Contract Theory

The relationship between the planner and the landowner can be analyzed as a principal-agent relationship. Adverse selection in relation to

agriculture and forestry has traditionally been applied to situations where agents have different cost or production functions; however, we would like to analyze the contractual relationship in order to gain a better understanding on the opportunity costs and private utility the landowner experiences in order to make the contract design more efficient.

Moral hazard and adverse selection are the two main issues which are dealt with in principal-agent settings. Both are a result of asymmetric information where the landowner has private information before (adverse selection) or after (moral hazard) the contract is signed. Here the relationship between landowners and the planner is analyzed in relation to adverse selection, because landowners are expected to have different management objectives, opportunity costs and private utility and we would like to gain knowledge on these differences in order to improve the contract design. The knowledge will help minimizing the asymmetric information.

The landowners' objectives will resemble the objectives of the planner to a greater or smaller extent and therefore some owners are expected to require smaller amounts of compensation compared with other owners. However, besides this we expect to find a trade-off between the levels of other attributes in the contract. Once this is known it can be used to further improve the efficiency and acceptance of contracts. The first studies to address the problems of adverse selection were Akerlof (1970) and Rothschild and Stiglitz (1976). Adverse selection issues are well known today and have been dealt with in modern textbooks of contract theory (Bolton and Dewatripont, 2005). Adverse selection analysis has been applied to forestry as a means for governments to improve market transparency and efficiency in forest certification (Rametsteiner, 2001). Furthermore, adverse selection has been applied to the pricing of irrigation water in relation to farmers who have heterogeneous production functions (Smith and Tsur, 1997). To our knowledge adverse selection has not previously been applied as a tool in the analysis of contractible background variables, contract attributes and variations in management objectives among landowners in relation to contracts for afforestation.

Method

The aim of the study is to investigate landowners' preferences for different attributes in the contract. In order to be able to generalize and to develop guidelines to improve contract design in Denmark it is useful with a representative sample of landowners. The Choice Experiment (CE) investigation will be conducted as an e-mail survey and will be sent to a random selection of Danish landowners.

The Choice Experiments method

The CE method is based on probabilistic choice models which rely on random utility theory. The utility of each alternative consists of the sum of systematic and error components. The systematic component, V , is a vector of observable individual and alternative specific attributes and the error component consists of all impacts and factors affecting the choice which are not observable by the researcher (Louviere et. al., 2000). The theory states that an individual will choose an alternative i from a specific choice set, C_n , given the indirect utility of i is greater than the indirect utility of any other choice j . This means that

$$U_{in} > U_{jn} \Rightarrow V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn} \quad \forall j \neq i; i, j \in C_n$$

Random utility theory states the probability by which an alternative is chosen given the systematic and error components. This means that the probability that an individual, n , chooses alternative i is the same as the probability that the utility of alternative i is greater than the utility of any other alternative of the choice set, which means

$$P(i) = P(V_{in} + \varepsilon_{in} > V_{jn} + \varepsilon_{jn}) \quad \forall j \neq i; i, j \in C_n$$

(Horne, 2006; Adamowicz et. al., 1997; Adamowicz et. al., 1998).

The CE method has been applied to a large number of investigations on valuation of non-marketed goods and recreational demand in relation to forestry in recent years (Hanley et. al., 2002; Boxall et. al., 1996; Biénabe & Hearne, 2006). However, so far only few investigations have been made on landowners' preferences with regard to contracts for nature protection or afforestation.

Choice experiments have been used to investigate landowners' attitude towards the optimal (perceived) population of moose in Finland (Horne & Petäjäistö, 2003). Furthermore, the method has been used to assess Hungarian farmers' valuation of agrobiodiversity on small farms (Birol, Smale and Gyovai, 2006). Horne (2006) has used CE to investigate Finnish forest owners' preferences and acceptability of contracts, however, only the welfare of forest owners is considered in the investigation.

By using the CE method it is possible to combine qualitative and quantitative attributes which is useful in this context where levels of compensation are combined with, among other things, aims of afforestation.

A common problem in stated preference methods like CE is to make people answer truthfully. In this situation, where we ask landowners about the relation between compensation and various attribute levels, it is likely that they set the compensation higher than what they would actually be willing to accept, if they believe it might raise the compensation in future subsidy schemes. However, CE is still believed to be the most appropriate stated preference method since it makes the respondent compare two alternatives with different attribute levels against each other. The method

provides us with the trade-offs between attributes over a broad spectrum of levels and these trade-offs will be relevant despite some degree of overstatement with regard to compensation. Nevertheless, this should of course be kept in mind when analyzing data.

The choice of respondents

The respondents are chosen among the group of landowners who have the option to afforest. This can be both forest owners and farmers (together defined as landowners). In Denmark local authorities have divided the land area into three types of afforestation zones; positive zones where afforestation is wanted, negative zones where afforestation is not wanted and neutral zones where it is possible (SNS, 2008b). The landowners are picked from the positive and neutral zones. Owners with all their land in areas where afforestation should be avoided (negative areas) are excluded from the sample.

It is interesting to have both respondents who already have forest areas and consider themselves as primarily forest owners and landowners who consider themselves primarily farmers since there might be a difference in their willingness to accept a contract for afforestation.

In Denmark 62.1% of forest owners consider themselves first and foremost as farmers and 26.1% consider themselves 'leisure time' forest owners (Boon, 2003). The overlap between the two groups is another argument which makes it preferable to focus on the landowners who live in afforestation areas rather than either forest owners or farmers.

The questionnaire

The introductory text and the afforestation scenario

The CE questionnaire includes an *introductory text* which aims at establishing the right setting and context for the owner before he/she answers the questionnaire, such as explaining briefly why afforestation is important. The aims of the survey (such as gaining knowledge on what landowners' find important in relation to afforestation contracts) will be explained. Furthermore, it will be pointed out to the owners that the answers will be kept confidential and specific answers and statements will never be linked to the individual. A common problem regarding the background variables is that people often refuse to state their income level. Therefore the introductory text will explain that the income level is necessary because the amount of payment/compensation needed concerning a specific contract is likely to vary with the income level. Afterwards follows an explanation of the attributes and attribute levels. In order to eliminate the effect of each owner reflecting on whether or not to afforest a specific area where we

do not know the characteristics and opportunity costs, we define the afforestation scenario so this will be common for all respondents.

The *afforestation scenario* will include information on size of area, establishment costs, and level of control. The afforestation area we characterize is arable land with wheat production and the average contribution will be stated. The expected establishment costs of the forest will be 30,000 DKK/hectare. The establishment of a new afforestation area can normally be complete within approximately 8 years and therefore the area will be checked after approximately 8 years in order to make sure that the contract is fulfilled. Moreover, it is stated what the expected yield of an established forest is.

The landowner will then be asked to choose the preferred alternative in the following choice sets. The forest owner should always have the option to choose neither of the alternatives (choose status quo) and, even though the status quo choice is shown as a box in the questionnaire, the option of refusing both alternatives will be emphasized in the introduction.

Background variables

The purpose of the background variables is to reveal information on how the relation between afforestation and compensation varies with characteristics of the owner and the land holding. Background variables are directly observable or accessible for the planner. This makes it possible to use the knowledge to develop new contractual variables and to gain knowledge about types of landowners in order to improve marketing.

Table 1 The background variables in the questionnaire and the possible use of each of them. X: can be used. %: cannot be used. ?: Maybe.

		Contracts	Marketing
Landowner characteristics	Age	? (%)	X
	Gender	%	X
	Level of Education	%	X
	Income	?	X
	Duration of ownership	?	X
	The primary source of income	?	X
	Full time / part time	? (X)	X
Facts about land holding	Area of forest and farmland and total	X	X
	Types of farm (animals or crops)	?	X
	Zip code	X	X

From society's perspective it will not be acceptable to use all the background variables we gather data on directly in contracts. For example, it would not be acceptable to offer differentiated compensation based on gender or level of education of the landowner even though it theoretically could be optimal to do so. Other variables, such as what is the main source of income or location of the land (zip code), might be contractible if they reveal significant differences in e.g. opportunity costs. If they can be included directly in the contract it can reduce the problem of adverse selection. An example is that existing Danish subsidy schemes for forest consultancy services use forest area as a contractible variable and differentiate the subsidy based on area.

The variables which are not socially acceptable to contract on have been included because the information they can bring forth may be useful in other ways. For example, if the planner knows that age or gender has a significant effect on the willingness to accept a specific contract, she can use this information to evaluate whether or not it is possible to reach her goal based on the proposed contract or if she has to make an extraordinary effort to get specific groups to participate as well. This could for example be through campaigns and information material which are targeted specific groups. All the 'marketing' attributes in table 1 can be used to improve campaigns.

Furthermore, the owner is asked questions concerning his objectives for owning the land and the importance of biodiversity and landscape values etc. He is asked how market prices influence his decision making, if he is concerned about water quality or biodiversity, if he has a private well, questions about if he would like to improve recreational options in the local area, if somebody else helps him make decisions, if he knows if there exist positive/neutral/negative areas for afforestation on his land, if he lives near to his land, if he has any previous experiences with contracts for different environmental goods etc. These questions are aimed at linking this investigation to previous studies of landowners (Boon, 2003) and to reveal information on possible explanations of the stated trade-offs.

The attributes

Table 2 Attributes to be used in the questionnaire and the different levels of each attribute.

Attributes	Levels of attributes
Aim of afforestation	Recreation Ground water protection Carbon sink Biodiversity
Size of area affected	5 hectare 20 hectare 50 hectare
Option of denouncing the contract	Binding contract Option of denouncing within 5 years Option of denouncing within 10 years
Timing of payment	All compensation now Half of the compensation now and half in year 8 All compensation in year 8
Compensation	10,000 DKK/ha 15,000 DKK/ha 20,000 DKK/ha 25,000 DKK/ha

Aim of afforestation

We investigate four aims of afforestation; recreation (to benefit people's leisure time activities in forests), groundwater protection, carbon sink (to help avoid global climate change) and biodiversity. These are all benefits of afforestation mentioned by The Danish Forest and Nature Agency in the Danish National Forest Programme (SNS, 2002). They are all public goods which are usually not marketed. Timber production is also mentioned by the

Danish Forest and Nature Agency but is not included since it is a marketed good.

The aim of the afforestation could have an effect on forest owners' willingness to accept a contract (and compensation) since they may have different preferences for the proposed aims. Owners may have different objective functions with regard to the scope of afforestation and perhaps experience private utility from creating a specific public good. Therefore, we would like to investigate if they experience different levels of utility depending on the main aim of the forest protection. So even if the opportunity cost of a specific contract is the same, the owners' preferences may vary if they for example believe that protection of water resources is a very important goal whereas afforestation for recreational purposes may be less important or conflicting with utility maximization. Another example is if a landowner uses the area for hunting, he/she might want to limit public access and thereby reject a contract for afforestation if the purpose is recreation.

Size of area affected

It is expected that the size of the area affected makes a difference to the landowner. A farmer who accepts to make afforestation on all his/her land is no longer a farmer and it is unlikely that he/she will accept this change since it causes a change in identity. An area can probably be too small as well making it unprofitable to spend time applying for the subsidy. The Danish Forestry and Nature Agency prioritize applications with an area above 10 ha and due to this it is interesting to investigate both areas below and above this limit (SNS, 2008c).

Option of denouncing the contract

Landowners are used to have all decision power and a loss of authority is expected to create a need for compensation. Since long term commitment and uncertainty with regard to market fluctuations are expected to be important factors when landowners choose a contract for afforestation, we investigate the value of having an option to denounce the contract within 5 or 10 years. If the landowner decides to denounce the contract he/she has to pay the subsidy back to the state (with a specified interest rate). However, the landowner will then be free to return the area to arable land. This will for example give the landowner the option to denounce the contract if the market for an alternative production suddenly improves a great deal. Since the landowner is used to production on a yearly basis it is interesting to investigate if the option to denounce is valuable for him/her. A binding contract means that the area will be forest reserve from the establishment; if the landowner has the option to denounce within 5 or 10 years, the area will

become forest reserve after this period if the owner does not denounce the contract before.

The current subsidy scheme does have an option to denounce the contract if the landowner within the first two years do not use the subsidy or do not plant trees. If he/she does it is no longer possible to return to farmland. Before 2004 it was possible to remove the forest and pay back the subsidy with rents (Jørgensen, 2008).

In the long run the planner is interested in subsidizing areas which become forest reserve, however, giving landowners and option to denounce the contract within a number of years may lead to more afforested areas in the long run as well, if the option is valuable for landowners and they would otherwise decline the contract. Leaving the authority to the agent in decisions of his concern is in theory said to increase the effort level or the agents (landowners) acceptance of the contract (Aghion & Tirole, 1997).

Timing of payment

We use this attribute to investigate to what extent the timing of the payment affects the landowner's decision to accept or decline the contract. The current subsidy scheme for afforestation offers more than half of the compensation when the contractual relationship is established and the rest after maximum 8 years (if planted) or 12 years (if seeding) when the new forest area is successfully established (SNS, 2008c). We investigate the current procedure and the effect of delaying the compensation to year 8 or, alternatively, paying the landowner all of the compensation when the afforestation is established in year 1.

When delaying the payment there is a trade-off between inducing incentive to choose high effort and exposing the agent (landowner) to risk (Macho-Stadler & Pérez-Castrillo, 2001). The state has an interest in delaying the compensation to year 8 and combines it with a control visit of the successful establishment of the forest. This is assumed to minimize the problem of moral hazard since the landowner has an incentive to choose a high effort level in order to improve the probability of success. This exposes the landowner to risk since it is not certain that he will get all the compensation if the afforestation is not successful. The landowner is expected to be risk-averse and due to this it will be costly to expose him to risk. The state is considered to be risk neutral because of the size and theory tells that the state should take all the risk. The aim of investigating the timing of payment is to gain knowledge which can help the planner designing a contract with an appropriate balance between incentives and risk. The landowner will benefit from a contract design which suits his risk aversion better.

Compensation

Compensation is the amount of DKK the forest owner will receive per hectare. The compensation will be paid according to the timing of payment stipulated in the contract. Moreover, compensation is an attribute which makes it possible to quantify the trade-offs between the other attributes which will be useful knowledge to improve contract design. The actual compensation in Danish afforestation schemes varies from 13,000 to 25,000 DKK/hectare with the highest level of compensation to plantation of broadleaves in positive areas and the lowest level for direct seeding in neutral areas (SNS, 2008c). We have chosen levels of compensation matching this frame and one with lower compensation level in order to investigate if it is possible to make people participate for less.

Discussion

The aim of this paper is to investigate landowners' preferences and trade-offs between different attributes in contracts for afforestation in order to improve the contractual relationship.

A discussion is whether the results can be used to improve contract design about nature management in general or only in afforestation contracts. It is expected that four of the five attributes (size of area, option of denouncing the contract, timing of payment and compensation) are important in other cases as well. This implies that if the answers should not be useable in general it is because the respondents see afforestation as something completely different than other types of nature management contracts and thereby have other trade-offs. The 'aim of afforestation' attribute which cannot be used in a questionnaire regarding e.g. biodiversity conservation can help reveal some of these trade-offs in relation to different aims. This makes it possible to state if e.g. public access through recreational use is expensive for the planner relative to e.g. groundwater protection. This value can be applied to biodiversity conservation if e.g. the main aim is to protect endangered species it would be expensive to ask the landowner to establish pathways through the area as well.

The afforestation case can influence the answers because of the irreversible nature of afforestation and time horizon. The fact that the afforested area will be forest reserve may make the landowners hesitant to afforestation. The increase in the market price of food is expected to lead to a decrease in the interest in afforestation. This makes it particularly interesting to investigate the option of denouncing the contract to see what the value is of making it possible for the landowner to see how the market develops and then later on having the option to cancel the contract if it is preferable. Still, there are several reasons for afforestation mentioned in the 'aim of afforestation' attribute and it is interesting to see how landowners value these purposes combined with a market situation which pulls towards

farming instead. The food prices might influence the answers in a negative way according to level of compensation seen from a planner's perspective. However, it may be possible to use the results to see which attributes have the strongest effect on the answers and thereby gain general knowledge about trade-offs.

Concluding remarks

We expect this future study to provide a better understanding of the private benefit/cost side landowners face when deciding whether or not to accept a contract for afforestation on their land. This knowledge, which currently is private information for the landowners, can be used to improve the contractual design in contracts for afforestation so it reflects landowners' preferences. This can be beneficial for both state and landowners. Moreover, we expect to gain knowledge on whether or not the aim of the afforestation has an effect on the private benefits/costs which the landowner experiences. Furthermore, we expect the irreversible decision of establishing a forest reserve to be a great step for most landowners/farmers who are used to dealing with arable land with yearly crops. Therefore we would like to investigate how valuable the option of denouncing the contract within a certain number of years is for the landowner.

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