The transferability and performance of payment-by-results biodiversity conservation procurement auctions: empirical evidence from northernmost Germany

Groth, Markus

WORKING PAPER

The transferability and performance of payment-by-results biodiversity conservation procurement auctions: empirical evidence from northernmost Germany

by
Markus Groth

University of Lüneburg
Working Paper Series in Economics

No. 119

February 2009

www.leuphana.de/vwl/papers

ISSN 1860 - 5508

The transferability and performance of payment-by-results biodiversity conservation procurement auctions: empirical evidence from northernmost Germany

Markus Groth[1]

Summary

Managed grasslands contribute in a number of ways to the biodiversity of European agricultural landscapes and provide a wide range of ecosystem services that are also of socio-economic value. Against the background of a rapid biodiversity loss in agricultural landscapes, increasing attention is being paid to farming practices that enhance ecosystem services. Therefore developing cost-effective conservation payment schemes is the main challenge facing present European agri-environmental policy. This paper deals with the transferability of a payment scheme that combines a payment-by-results approach with the use of discriminatory-price conservation procurement auctions in order to improve the cost-effectiveness of conservation schemes for grassland plant biodiversity. Hence the design, implementation and results of the adapted case-study payment scheme in the county Steinburg in the northernmost federal state of Germany (Schleswig-Holstein) will be focussed. Results concerning the ecological-effectiveness of the payment-by-results approach as well bid-prices and potential cost-effectiveness gains by the use of conservation procurement auctions point out that it was possible to transfer the payment scheme successfully to another region, whereby the adapted case-study even outperforms the original case-study.

Keywords: agri-environmental policy, discriminatory-price auction, ecological services, experimental economics, multi-unit auction, payment-by-results, plant biodiversity, rural development.

JEL-Classification: C93, D44, H41, Q24, Q28, Q57, R52.

[1] Dr. Markus Groth, Leuphana University of Lueneburg, Sustainability Economics Group, Scharnhorststr. 1, 21335 Lueneburg, E-mail.: groth@uni-lueneburg.de, Phone: +49.4131.677-2636, Fax: +49.4131.677-1381.

1 Introduction

Developing a cost-effective conservation-compatible land use policy to influence private land management is the main challenge facing present European agri-environmental policy. Thereby the protection of ecosystem services as well as the preservation of biodiversity is a main objective, both from an economic and ecological perspective. Biological diversity contributes in a variety of ways to human well-being (Sala and Peruelo, 1997; MEA, 2005; Sukhdev et al., 2008). Ecosystems as well as non-market goods and services they generate thereby play a central role (Chapin III et al., 2000; Balvanera et al., 2001; Balmford et al., 2005; MEA, 2005; Balvanera et al., 2006; Egoh et al., 2007; Jackson et al., 2007; Öckinger and Smith, 2007).

Against the background of a rapid biodiversity loss in agricultural landscapes, increasing attention is being paid to farming practices that enhance ecosystem services (MEA, 2005; Jackson et al., 2007; Ferraro, 2008).

In the European Union (EU), agri-environmental programmes are the most important policy instrument to conserve biodiversity by providing monetary incentives to farmers by means of compensation payments. Since the reform of the Common Agricultural Policy (CAP) in 1992 such voluntary incentive schemes have been supported by the EU as part of the second pillar of the CAP.

However, current action-oriented agri-environmental programmes aimed at conserving biodiversity involve a number of potential drawbacks like vaguely defined objectives, a lack of monitoring and a poor uptake due to management restrictions (Ferraro and Kiss, 2002; Gerowitt et al., 2003; Kleijn and Sutherland, 2003; Zechmeister et al., 2003; Kleijn et al., 2006; Whitfield, 2006; Von Haaren and Bathke, 2007). Even if the practical implementation of payment-by-results approaches is still limited to few case-studies and programmes, paying landowners based on ecological result instead of compensating them for carrying out predetermined management agreements[2] has several potential advantages over the current schemes, as follows (Musters et al., 2001; Ferraro and Kiss, 2002; Gerowitt et al., 2003; Wittig et al., 2006, Von Haaren and Bathke, 2007): i) a shift away from rigid requirements and targets for action, ii) a payment solely based on actual ecological results, iii) the promotion of self-interest of landowners concerning the environmental performance and the ecological capital of their managed grassland sites, iv) the inclusion of the farmer's specific experience and knowledge, v) a higher potential for innovation, vi) a reduction of information asymmetries, vii) a better control of the ecological-effectiveness of

[2] For instance, compensation is paid for not cutting a grassland parcel before a certain date.

conservation payment schemes, and iix) a higher acceptance of payments as part of agri-environment programmes.

The prerequisite for a payment-by-results approach for plant biodiversity is that ecological services need to be standardised according to their ecological quality and must meet certain conditions and requirements. This implies that ecological services are valuable goods and could be detected without complicated methods. Furthermore, the ecological goods should act as an indicator and – in addition to their actual usefulness – should imply positive effects on other natural resources.

Within current action-oriented agri-environmental programmes, farmers receive a fixed flat-rate payment, based on the estimated average opportunity costs of carrying out predetermined management measures. Thus, there are also concerns that the cost-effectiveness of agri-environmental programmes is often unsatisfying. Low-cost producers gain informational rents (overcompensation) and landowners with opportunity costs above the flat-rate payment will not participate, due to missing incentives. This is mainly the case since in contractual relationships involving payments for environmental services, the conservation agency knows less than the landowner knows about the costs of contractual compliance. Therefore landowners may use their private information to extract informational rents (Fraser, 1995; Wu and Babcock, 1996; Latacz-Lohmann and Van der Hamsvoort, 1997; Latacz-Lohmann and Van der Hamsvoort, 1998; Cason et al., 2003; Stoneham et al., 2003; Cason and Gangadharan, 2004; Groth, 2007; Lowell et al., 2007; Pascual and Perrings, 2007; Schilizzi and Latacz-Lohmann, 2007; Claassen et al., 2008; Ferraro, 2008). Reducing such informational rents, therefore, is an important task for buyers of environmental services who wish to maximize the services obtained from a limited budget.

Hence, conservation agencies should try to pay farmers for the provision of environmental services in the most cost-effective way. A promising approach to achieving this goal is the strengthening of incentive mechanisms and market-creation by the use of conservation procurement auctions. Within such auctions a buyer of environmental services (the conservation agency) invites bids from suppliers of environmental services (the landowners) and closes contracts with the lowest bid-prices. The potential benefit of this approach is the possibility to close conservation contracts based on individual costs of contractual compliance, as represented by differentiated bid-prices.

The European Union's Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) has

already introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts: 'Where appropriate, the beneficiaries may be selected on the basis of calls for tender, applying criteria of economic and environmental efficiency' (article 39, Council Regulation (EC) No 1698/2005).

However, there is still a serve shortage of knowledge and practical experiences and the evaluation of conservation procurement auctions in Europe is restricted to few scientifically supported case-studies or pilot-programmes (section 2.3). Furthermore, since these case-studies have been limited to one region (county) there is still a lack of clarity whether such payment schemes could be transferred to other regions. This paper, therefore, especially deals with the transferability and performance of a payment scheme that combines a payment-by-results approach with the use of discriminatory-price conservation procurement auctions for grassland plant biodiversity.

The paper is structured as follows. The second section introduces conservation procurement auctions as well as different payment formats and presents the current state of practical experiences and cost-effectiveness gains of conservation procurement auctions. Section three briefly discusses the original case-study, whereby both the case-study design and the main results will be highlighted. Section four discusses the design, transferability and performance of the adapted case-study. Thereby the conducted adjustments and the results of the submitted and successful bids as well as potential cost-effectiveness gains will be focused. Section five concludes and briefly highlights current need for research.

2 Conservation procurement auctions

2.1 Basics

The procurement of ecological goods and services for which there are no well-established markets is commonly performed by using conservation procurement auctions. The main reason why auctions are a promising approach is the presence of an information asymmetry between the farmers and the administration. This is the case since these goods and services are often generated by lands that are private property. A landowner usually knows his own land as the base of production opportunities better than any public agency (Fraser, 1995; Wu and Babcock, 1996; Latacz-Lohmann and Van der Hamsvoort, 1997; Latacz-Lohmann and Van der Hamsvoort, 1998; Cason et al., 2003; Stoneham et al., 2003; Cason and Gangadharan, 2004; Groth, 2007; Lowell et al., 2007; Pascual and Perrings, 2007; Schilizzi and Latacz-Lohmann, 2007; Claassen et al., 2008; Ferraro, 2008). Conservation procurement auctions use bidding rules and market competition to

reduce incentives for sellers to inflate their contract prices and are tools to induce landowners to reveal their private information, whereby landowners will calculate bid-prices based on their individual costs. Auctions to buy ecological services from landowners, therefore, focus on budgetary cost-effectiveness and the possibility to gather information about the production costs of agricultural firms (Wu and Babcock, 1996; Latacz-Lohmann and Van der Hamsvoort, 1997; Latacz-Lohmann and Van der Hamsvoort, 1998; Cason et al., 2003; Stoneham et al., 2003; Cason and Gangadharan, 2004; Naidoo et al., 2006; Drechsler et al., 2007; Groth, 2007; Claassen et al., 2008; Ferraro, 2008).

Standard selling auctions can be adopted as procurement or reverse auctions, like in the case of auctioning ecological services. But auction theory (Klemperer, 1999; Klemperer, 2002; Krishna, 2002; Chan et al., 2003) does not offer clear guidance for biodiversity conservation contract auctions because these specific auctions have unusual attributes (Latacz-Lohmann and Schilizzi, 2005; Ferraro, 2008).

A main aspect is that conservation procurement auctions are usually repeated auctions over a sequence of time periods. The results are binding for each time period, but there will be future opportunities to bid on the same units and bids for the same ecological service on one site are invited in a sequence of various bidding rounds instead of a one-shot auction. This allows bidders to take into account the results of previous auctions and to adjust their bids (Reichelderfer and Boggess, 1988). Also to be mentioned is the number of goods traded. The relevant units are in general contracts that specify – for a period of time – a level of environmental services or an observable set of land uses that are offered in exchange for a payment. Landowners may be allowed to offer single or multiple units, which may be divisible or indivisible, homogenous or heterogeneous (Kagel and Levin, 2001; Hailu and Thoyer, 2006). Conservation procurement auctions are multi-unit procurement auctions and the administration selects various farmers with a number of heterogeneous sites to take part in the auction. Furthermore, it needs to be considered that conservation auctions can be used either as budget-constraint auctions or as target-constraint auctions (Latacz-Lohmann and Schilizzi, 2005). The budget-constraint auction is the usual case that agri-environmental schemes have a limited budget to spend and bids are accepted until the budget is exhausted. Another aspect of designing conservation procurement auctions is the question of whether a reserve price should be set. A reserve price is a price limit that defines the maximum amount that the administration is willing to accept (Stoneham et al., 2003; Latacz-Lohmann and Schilizzi, 2005).

2.2 Payment format and auction design

Standard auction theory has employed two basic models (Klemperer, 1999; Klemperer, 2002; Krishna, 2002; Chan et al., 2003). In the private-value model each bidder has an individual knowledge about the value of the object in question. This value remains private information and is not revealed in the auctioning process. In contrast, in the common-value model the value of the object is equal for all bidders involved in the auction. However, the bidders have different private information about what that value actually is. In this case, bidders change their estimates if they take into account other bidders' signals via bids. In contrast, the values in the private-value case would not change based on additional information by other bidders' preferences or bids.

Landholders within conservation procurement auctions are assumed to have independent private values. This seems to encourage a single round of bidding, whereby it is to be expected that bids will be based on individual opportunity costs. But in practice conservation procurement auctions are usually repeated auctions and a common-value element may arise; landholders might analyse the results of previous auctions and accordingly update their bids (Latacz-Lohmann and Van der Hamsvoort, 1997). As long as no information is available on how the conservation agency values the sites with respect to their conservation value, the landholders will have different assumptions on the relative value of their land.

In order to avoid information rents and collusion, it has to be considered carefully which information will be given to bidders. Consequently, only sealed-bid auctions are appropriate and there are two basic payment formats to be used within repeated multi-unit conservation procurement auctions. Both payment formats will now be briefly discussed, in particular regarding strategic incentives and the expected farmers' bidding behaviour (Milgrom, 1989; Latacz-Lohmann and Van der Hamsvoort, 1997; Stoneham et al., 2003; Cason and Gangadharan, 2004; Cason and Gangadharan, 2005; Latacz-Lohmann and Schilizzi, 2005; Ferraro, 2008):

i. A sealed bid – stating the individual price for a specific ecological service – is submitted by each bidder in the uniform-price procurement auction. The good is then bought at a price determined by the price of the highest winning bid or the lowest rejected bid. All successful bids are paid equal. Thus the individual bid-price determines the probability of acceptance, but not the final payment. The optimal bidding strategy, therefore, is to reveal the accurate opportunity costs.

ii. In the discriminatory-price procurement auction also a sealed bid is submitted for every site, but all accepted bids are receiving payments according to the individual bid-price.

This auction design implies incentives for bidders to bid a price above the individual opportunity costs and to ensure themselves information rents, if the bid finally is successful.

The theory of budget-constrained auctions suggests that it is optimal for bidders in a discriminatory-price procurement auction to overbid relative to their true costs of providing the ecological good (Latacz-Lohmann and van der Hamsvoort, 1997; Cason and Gangadharan, 2005). The bid curve, therefore, does not represent the true cost curve; it rather contains a rent for the bidder. Hence the supply curve is not identical within discriminatory-price procurement auctions and uniform-price procurement auctions, whereby the true opportunity costs equal the bid-prices within a uniform-price auction. The latter is based on the true marginal cost curve of environmental service provision, without a rent element. A discriminatory-price procurement auction does thus reveal differences in opportunity costs, but – because of the incentive to overbid – only imperfectly so. On the basis of theoretical considerations a uniform-price procurement auction seems to be the best choice since it creates no incentives for overbidding the individual opportunity costs. However, whether informational rents are actually higher under a uniform-price payment format or under a discriminatory-price payment format is obviously an empirical question.

Under standard assumptions the two payment formats yield the same expenditures (Milgrom, 2004). However, the characteristics of conservation procurement auctions are unlikely to result in expenditure neutrality (Ferraro, 2008). Results from Riley and Samuelson (1981) suggest that discriminatory-price conservation procurement auctions can yield lower expenditures for risk-averse landowners because the payment is a non-stochastic income component. Therefore it would reduce the farmers' income uncertainty. To obtain this kind of decrease in uncertainty, risk-averse landowners have an incentive to reduce their bid-prices below the bid-prices of risk-neutral landowners. The greater the risk aversion and the greater the dispersion in opportunity costs, the more likely the discriminatory-price conservation procurement auction would require lower expenditures for a given level of environmental services. Because theory does not offer clear guidance on an appropriate auction design, experiments and agent-based modelling have become popular in order to learn about the performance of different payment formats. In laboratory experiments, McKee and Berrens (2001) and Cason and Gangadharan (2005) find discriminatory-price conservation procurement auctions are less costly than uniform-price

conservation procurement auctions for a given environmental objective. In an auction that allows bid revisions, Cummings et al. (2004) find that average bid-prices are initially lower in the discriminatory-price conservation procurement auction, but the difference disappears as bidders revise their offers. Using agent-based modelling of multi-unit conservation procurement auctions, Hailu and Thoyer (2005) find that overbidding made the discriminatory-price conservation procurement auction more expensive than a uniform-price conservation procurement auction. Auction outcomes are thus sensitive to the bidding rules and the characteristics of the contracts and bidders.

Two other relevant aspects of pricing rules are fairness (Ferraro, 2008). In some cases, paying everyone the same price may be considered fairer than discriminating by individual opportunity cost (same ecological service, same payment). In other cases, paying everyone the same price regardless of their opportunity costs may be considered unfair (and a waste of taxpayer money).

Facing the practical considerations of a case-study implementation some further aspects need to be considered. A main argument against uniform-price conservation procurement auctions is that farmers with low opportunity costs would benefit disproportional from a higher payment, because the strike price reflects the required compensation for owners of more productive sites. In contrast, a discriminatory-price conservation procurement auction does not pay landholders more than what they bid. The critical incentive on overbidding the individual opportunity costs a part of a discriminatory-price payment will most probably be reduced to some degree by using flexible reserve prices. Furthermore, it is to be expected that bidders will take into account information on the uniform payment within repeated uniform-price procurement auctions and adjust their bid-prices.

Hence, the choice between both payment formats is obviously still controversial in practice. As part of the original case-study (section 3) the discriminatory-price conservation procurement auction proved to be the appropriate payment format against the background of repeated auctions as well as the objective of a high acceptance by farmers. Therefore, an equal auction design had been used within the adapted case-study (section 4) and will be analysed with respect to its transferability.

2.3 Practical experiences and cost-effectiveness gains

Auctioning has a longstanding tradition in government procurement contracting, but has been limited to trade commodities as for example public works, electricity and emission rights (Chan

et al., 2003). Using auctions to conserve natural resources is a relatively new approach. In some cases specific auctions have already been used for the provision of public-good type environmental benefits from landowners in the countryside. Since 1986 the U.S. Department of Agriculture has been awarding land retirement contracts for the Conservation Reserve Program (CRP) based on a competitive bidding mechanism. Farmers bid to obtain CRP cost share assistance, which is allocated to them based on a so-called Environmental Benefit Index (Reichelderfer and Boggess, 1988; Babcock et al., 1996; Claassen et al., 2008). In Australia, conservation procurement auctions are used for objectives such as salinity control, nutrient control and conservation of native vegetation where land use change is required to achieve environmental improvement as part of the BushTender trials and other projects as part of the Market-based Instruments Pilot Program (Stoneham et al., 2003; Grafton, 2005; National Market Based Instrument Working Group, 2005). In Europe, a conservation scheme combining auctioning and fixed-price payments had been used in two counties in the state of North Rhine-Westphalia, Germany (Hilden, 2007). Moreover, the Central Scotland Forest and Grampian Challenge Fund was based on auctioning to encourage additional afforestation on private land (CJC Consulting, 2004).

Mainly the following conservation procurement auctions – besides both German case-studies considered in this paper – had been, or are still, implemented in practice:

- The Conservation Reserve Program in the United States
- The Central Scotland Forest and Grampian Challenge Fund in Scotland
- The BushTender trial in Australia (including the Southern Victoria Bush Tender, the Gippsland Trial, the Habitat Tender, the Northeast River Tender, the Plains Tender, the programme Bush Returns and the EcoTender as BushTender trial types of programmes)
- The Market-based Instruments Pilots Program in Australia (including the programme Auction for Landscape Recovery)
- The research project Ausschreibung von Agrarumweltprogrammen am Beispiel der MSL-Grünlandextensivierung [Auctioning agri-environmental payment schemes for an extensive use of managed grasslands] in Germany
- The pilot auction as part of the research project Experimental Field Auctions and Soil Erosion Control in Indonesia.

Even though very promising from a theoretical perspective and in some cases already approved in practice, there is still little evidence about efficiency and cost-effectiveness gains of auctions compared to payment schemes using fixed flat-rate payments. Furthermore, reported results on cost-effectiveness gains vary greatly. Stoneham et al. (2003) mention that the first auction within the BushTender trial had lead to an amount of biodiversity that would have cost up to seven times more if a fixed-price payment scheme had been used instead of the auction. A simulation of farmers' bidding behaviour within a hypothetical payment scheme auctioning conservation contracts by Latacz-Lohmann and Van der Hamsvoort (1997) points out efficiency gains – depending on the auction design – from 16 to 29 per cent. An evaluation of the Central Scotland Forest and Grampian Challenge Fund for the Forestry Commission Scotland by CJC Consulting (2004) reports efficiency gains in the range of 33 to 36 per cent. Within the Catchment Care Program as part of the National Market-based Instruments Pilot Program in Australia, an auction for biodiversity and water quality – ones in place – would be expected to be between 23 and 34 per cent more cost-effective than the former fixed price scheme (National Market Based Instruments Working Group, 2005). White and Burton (2005) were able to use data from the program Auction for Landscape Recovery to benchmark the cost-effectiveness of the auction to an equivalent flat-rate payment scheme. They show that the cost-effectiveness gains of the auction vary between 207 per cent and 315 per cent in the first auction and 165 per cent and 186 per cent in the second auction, whereby the results depend on whether the fixed price scheme is input-based or output-based. A case-study in the Northeim region in Germany (the case-study is part of this paper as the original case-study or 'Northeim-project'; section 3) shows a potential for cost-effectiveness gains in the range of 21 to 36 per cent (Groth, 2007; Groth, 2008a).

3 The original case-study ('Northeim-project')[3]

3.1 Payment scheme and auction design

The original case-study conservation procurement auctions have been carried out as part of a research programme to conserve environmental services in agriculture. Within the payment scheme, regional-specific environmental goods of plant biodiversity had been rewarded as results

[3] Within this paper, the original case-study will only be presented briefly and focussed on main aspects. For a detailed discussion of the design and performance of the conservation procurement auctions as part of the case-study, see Groth (2007; 2008a). The specific farmers' private transaction costs for the case-study conservation procurement auctions are discussed in Groth (2008b). For a more general discussion of the case-study and results of the on-the-spot controls, see Klimek et al. (2008).

of environmental services of agriculture. These ecological services were defined as ecological goods of plant biodiversity (Bertke, 2005), whereby the production of these so-called ecological goods 'grassland' aimed at the protection of regional endangered plant communities, the preservation of grassland on marginal sites and the promotion of species-rich grassland. The ecological goods and their represented ecological quality were defined by the number of different species per control plot (circle with 2m radius = 12.6m²), as follows: grassland I: number of species >= 8/12.6m²; grassland II: number of species >= 8/12.6m² + 2 target species; grassland III: number of species >= 8/12.6m² + 4 target species. For that purpose, 40 species were selected and included in a catalogue of species as part of the bidding documents (Bertke, 2005).

From an economic point of view, the bid-price per hectare was taken into account. The ecological evaluation was based on the classifications grassland I, grassland II and grassland III. Thus within every category of ecological goods different prices had been paid for a homogeneous ecological good.

The specific auction design was a repeated sealed-bid discriminatory-price multi-unit conservation procurement auction, with a separate budget-constraint for each quality of ecological goods. The regional demarcation corresponded to a uniform exclusion border. To safeguard a high number of participants and low possibilities for collusion, all farmers were allowed to take part with all their grassland sites located in the case-study area. In both auctions the same (potential) cohort of farmers was part of the field experiment, mainly to learn about the bidding behaviour and the specific performance of repeated conservation procurement auctions.

Landowners not exactly meeting the ecological requirements of the ecological good the bid targeted on had not been paid at all. Thereby it was left to the farmers to decide how to achieve the desired grassland I, II or III status. The results were assessed by means of on-the-spot controls on the grassland sites at the end of the contract period. As part of the on-the-spot controls the number and quality of different species were evaluated in control plots, representative for the whole grassland site. Successful farmers got paid in both auctions.

Since bidding behaviour is very sensitive to the type and amount of information communicated to farmers, no information except the definition of the ecological goods as part of the specification of services and the terms to be maintained was given to potential bidders in both auctions. The budget was not pre-announced in both auctions and the potential bidders in the second auction were not informed about the highest accepted bid-prices. Due to the fact that both auctions were part of a research project, an interdisciplinary group of researchers acted as the auctioneer and

evaluated the bids. The original case-study enfolded two field auctions. The first auction took place in the time-period 2004/2005 and the second auction took place in 2006 (Groth, 2007; Groth, 2008a).

3.2 Results – auction performance

The results of the original case-study will now be presented briefly.[4] To participate in the case-study, landowners had to submit an individual bid for each grassland site, whereas all farmers were allowed to submit a various number of bids for all categories of ecological services. Main results of the **submitted bids** are presented in table 1.

Table 1. Results of both auctions for the ecological goods grassland I, II and III (submitted bids)

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		
- Range of prices in €/ha	40 – 250 (Ø 100.92; SD 47.18)	25 – 160 (Ø 93.94; SD 29.47)
- Number of sites	130	216
- Hectare	221.16	340.65
- Number of farmers	27	26
Grassland II		
- Range of prices in €/ha	55 – 300 (Ø 141.75; SD 59.55)	75 – 300 (Ø 147.67; SD 46.92)
- Number of sites	32	56
- Hectare	53.33	82.58
- Number of farmers	16	18
Grassland III		
- Range of prices in €/ha	100 – 350 (Ø 202.78; SD 78.73)	150 – 450 (Ø 257.35; SD 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

Source: Groth, 2008a, p. 9. Ø = mean; SD = standard deviation.

If we take a look at the wide ranges and standard deviations of individual bid prices within each category of ecological goods and both auctions, it becomes clear that the farmers were actually confronted with different opportunity cost for the provision of an – in each case – equal quality of ecological services. The price level increased – as expected – within both auctions from good grassland I about good grassland II up to good grassland III.

Besides the submitted bids, the paper will now briefly discuss the **successful bids** presented in table 2 for both auctions and all three categories of ecological goods. It needs to be remembered that both auctions had been budget-constraint auctions with no reserve price. The total budget

[4] For a detailed discussion, see Groth (2007; 2008a).

restriction of €30,000 for the first auction was basically decided to be spend on two-thirds (€20,000) for the ecological goods grassland I and both on one-sixth (€5,000) for the ecological goods grassland II and grassland III, but with the option of shifting some of the budget to higher-quality goods, depending on the number and size of sites. For the second auction a total budget of €26,000 was available and the budget was spent equally (about €8,667) for all three ecological goods.

In consequence of the total budget-restriction of €30,000 not all bids in the total amount of €33,747.91 could be accepted within the first auction. Finally, 159 sites by 28 farmers – covering an area of 288.56 hectare – were taken under contract. With a total bid sum of €51,481.23 the budget-restriction of €26,000 was also exceeded in the second auction and therefore altogether 164 sites by 21 farmers were accepted, whereby 238.46 hectare of species-rich grasslands had been covered.

Table 2. Results of both auctions for the ecological goods grassland I, II and III (successful bids)

	1st auction (2004/2005)	**2nd auction (2006)**
Grassland I		
- Range of prices in €/ha	40 – 145 (Ø 84.59; SD 26.45)	25 – 90 (Ø 66.86; SD 15.56)
- Number of sites	109	89
- Hectare	198.25	130.05
- Number of farmers	20	10
Grassland II		
- Range of prices in €/ha	55 – 300 (Ø 141.75; SD 59.55)	75 – 200 (Ø 137.87; SD 30.92)
- Number of sites	32	52
- Hectare	53.33	76.80
- Number of farmers	16	17
Grassland III		
- Range of prices in €/ha	100 – 350 (Ø 202.78; SD 78.73)	150 – 450 (Ø 257.35; SD 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

Source: Groth, 2008a, p. 11. Ø = mean; SD = standard deviation.

The results clarify a wide range of individual bid-prices and thus the consequences of the discriminatory-price payment format for conservation contracting. The bid-price levels in both auctions show an increase from the ecological goods grassland I about the ecological goods grassland II up to the ecological goods grassland III. The price level decreased from the first to the second auction both for the ecological goods grassland I and grassland II, mainly due to an adjustment by reducing the specific budget-constraint.

On the other hand, the price level and the highest successful bid-price per hectare for the peak quality of biodiversity – represented by the ecological goods grassland III – increased from the first to the second auction. This increase had been caused by an adjustment of the subdividing of the total budget-restriction on the three categories of ecological goods in the second auction. As a reaction concerning an unexpected high amount of bids for the ecological goods grassland III in the first auction, the specific budget-restriction and the valuation of the highest-quality grassland sites was enhanced absolutely as well as compared to the remaining two classifications of ecological goods.

Due to the fact that the whole budget was spend for every ecological good, a comparison of table 1 and table 2 suggests that there was no real competition for the grassland II and III contracts, since all applicants but one won a contract. This must have had a negative effect on bidding behaviour, especially compared to grassland I contracts for which there was a lot of competition. To avoid this rise of accepted bid-prices and to increase competition among farmers, a reserve price of for example €300 per hectare should have been used for grassland III. But based on discussions within the research project the idea of using reserve prices – at least in the second auction and based on the results of the first auction – was rejected by the majority, bringing forward the argument that the main objective should be to take as much high-quality grassland sites under contract as possible; without considering a rise in prices and less budgetary cost-effectiveness. This needs to be mentioned as a specific drawback of interdisciplinary decision making and as a restriction within the original case-study.

Finally the main results of the potential for **cost-effectiveness gains by auctioning compared to fixed flat-rate payments**[5] will be introduced for the original case-study (see section 4.2.3 for a brief general discussion on methodological questions and restrictions of analysing the specific potential for cost-effectiveness gains in practice). In the first auction 198.25 hectare were taken under contract, whereas the relevant budget sums up to €16,100.84. To achieve the equivalent area by using a flat-rate payment of €103 per hectare a total budget of €20,419.75 would have been needed. Auctioning has in this case gained savings of €4,318.91 or – in other words – cost-effectiveness gains of 21.2 per cent. The similar comparison for the second auction approves –

[5] Compared to the 'Lower Saxony agri-environmental programme, measure B: support of extensive grassland use". This support of an extensive use of grassland fits best with the ecological good grassland I, whereas the latter even represents a higher ecological quality because the auction rewards an extensive use of grassland sites plus the proof of a specific amount of plant biodiversity indicated by eight different species. By the time the case-study took place, farmers were paid by a flat-rate payment of €103 per hectare within the agri-environmental programme.

and even strengthens – this positive appraisal. By using the flat-rate payment of €103 per hectare, a budget of €13,395.15 would have been needed to attain the ecological objective of 130.05 hectare grassland taken under contract in 2006. This objective has been achieved by auctioning with a budget of €8,527.30, which equals savings of €4,867.85 (36.3 per cent) (Groth, 2007; Groth, 2008a).

4 The adapted case-study ('Steinburg-Project')

4.1 Payment scheme and auction design

The objective of the adapted case-study was – similar to the original case-study – to reward landowners for their voluntary provision of regional-specific plant biodiversity of environmental services in a cost-effective way. Thereby the payment was – contrary to the majority of current agri-environmental programmes in the EU – not based on actions undertaken by farmers, but result-orientated, based on specify plant species richness. These results have to be clearly defined by transparent floristic criteria, so farmers are able to prove their fulfilment and a justifiable control can take place as part of the payment scheme. Moreover, ecological goods have to be bound to a particular grassland site. In order to make sure that the provision of ecological goods complies with the European legislation, these goods further have to be defined by criteria which go beyond the requirements of Good Farming Practice and Cross-Compliance.

For this purpose also the number of species is taken into account, but a first adjustment has been made. Thereby the former catalogue of 40 regional-specific species from the original case-study has been reduced to 32 regional-specific species and tailored to the specific characteristics for regional plant communities that are suitable for the case-study area.

In order to reduce the complexity of the payment scheme and to use a payment-by-results definition that equals payment-by-results agri-environmental programmes recently implemented in Germany, a second adjustment has been made by using two and not three quality classifications. Thereby the payment-by-results approach is based on the number of different species per segment on a representative transect and not based on different species per representative control plots, like in the original case-study. This third adjustment has been accomplished because the method of using transects has approved to be more practicable and more precise (Voß and Jödicke, 2006). Thereby each grassland site was crossed by one transect and each transect was divided into three equal segments. Two ecological quality classifications were defined, as follows: i) quality I: at least four different forb species within all three segments

on the transect; ii) quality II: at least six different forb species within all three segments on the transect. Hence, this payment-by-results approach based on plant biodiversity shall mainly achieve i) the maintenance of grassland on marginal sites, ii) the promotion of regional species-rich types of grassland and iii) the conservation of rare plant associations.

Within the adapted case-study, the first auction had been carried out in 2007 and the second auction took place in 2008, whereby the timetable was basically the same. The offer period ended for both auctions on the 15th of April and the compliance with requirements was verified by means of on-spot-controls until the end of June. From an economic point of view, the bid-price per hectare was taken into account and farmers were paid for conserving plant diversity that is used as a proxy for ecological services provided by species-rich grassland.

Thereby a fourth adjustment had been made. Contrary to the original case-study, the farmers had not yet to determine whether they bid on the quality classification quality I or quality II. The farmers only had to state a price, which they think is adequate if the requirements for quality I or quality II will be fulfilled on the specific grassland site. This adjustment mainly aims to reduce farmers' risk within the payment-by-results approach. Based on the results of on-the-spot controls, the grassland sites have been classified as i) ineligible, ii) quality I or iii) quality II. Based on the results of on-the-spot controls and according to the individual bid-prices for quality I or quality II, the successful farmers were paid in July.

The auction design in the adapted case-study also was a budget-constraint sealed-bid discriminatory-price conservation procurement auction. All farmers were enabled to take part in the field experiment auctions with their grassland sites located in the case-study area (the county Steinburg in Northern Germany). The data used in the paper is based on the results of two field experiment conservation procurement auctions. In both auctions the same (potential) cohort of farmers was part of the field experiment. No information except the definition of the ecological quality classifications as part of the specification of services (by the use of a brochure with coloured photographs and descriptions of indicator species) and the terms to be maintained was given to potential bidders in both auctions. The budget also was not pre-announced in both auctions and the potential bidders for the second auction were not informed about the highest accepted bid-price in the first auction.

4.2 Results – auction performance

4.2.1 Submitted bids

All farmers in the case-study area were allowed to submit a various number of bids for both ecological quality classifications. Thereby an individual bid had to be submitted for every grassland site. The presentation and discussion of the auction results is based on the scale of a grassland site. The number of farmers equals the number of bids, whereby each bid contains one or more different grassland sites with different bid-prices. The results of the submitted bids are presented in table 3.

Table 3: Submitted bids within both auctions – main results

	Auction 2007	Auction 2008
Quality I		
- Range of bid prices (€/ha)	30 – 150 (Ø 64,94 ± 22,43)	30 – 150 (Ø 67,71 ± 25,18)
- Payments (€)	19	18
- Number of farmers	66	62
- Number of sites	0,25 – 11,56 (Ø 3,29 ± 1,97)	0,17 – 6,49 (Ø 2,76 ± 1,47)
- Total area (ha)	217,09	171,08
Quality II		
- Range of bid prices (€/ha)	50 – 160 (Ø 90,41 ± 32,97)	60 – 250 (Ø 113,17 ± 51,39)
- Payments (€)	18	17
- Number of farmers	64	59
- Number of sites	0,25 – 11,56 (Ø 3,36 ± 1,96)	0,17 – 6,49 (Ø 2,69 ± 1,46)
- Total area (ha)	214,92	158,76

Source: own. Ø = mean; ± = standard deviation.

Table 3 shows a wide range of bid-prices for an – within each quality classification – equal amount of floristic plant biodiversity. Against the background of discussing the issue of possible negative influences of collusion within repeated conservation procurement auctions, it is important to point out that the range of bid-prices has not changes for quality I and has even increased for quality II. Moreover, the standard deviation slightly increased for the quality I grassland sites and greatly increased for the high quality grassland sites. Thus, within both case-study auctions there is no evidence for collusive bidding behaviour.

It already becomes clear that the case-study auctions have met one of their main objectives. By implementing a market for plant biodiversity by means auf conservation procurement auctions it was possible to learn about differences in farmers' opportunity costs of providing and maintaining floristic biodiversity in the case-study area. Hence this information was used to reduce the information asymmetry between the conservation agency and the farmers.

Due to the approach that farmers had not to decide mandatory whether they bid for quality I or quality II, there is an inevitably empirical constraint that each grassland site is included both in the submitted bids for quality I and quality II. Therefore, it is not possible to draw any further meaningful conclusions from the results of the submitted bids within the adapted case-study.

4.2.2 Successful bids

Besides the discussion of submitted bids, the question arises which of these bids could be taken under contract and rewarded with the given budget. The bids (grassland sites) have been evaluated by means of on-the-spot controls, whereby the successful farmers have been paid according to their individual bid-price for quality I or quality II, respectively. Main results of the successful bids are presented in table 4.

Table 4: Successful bids within both auctions – main results

	Auction 2007	Auction 2008
Quality I		
- Range of bid prices (€/ha)	30 – 100 (Ø 65,00 ± 21,49)	30 – 80 (Ø 58,42 ± 13,62)
- Payments (€)	101,40 – 708,60 (Ø 248,67 ± 174,32)	10,45 – 439,33 (Ø 158,17 ± 108,48)
- Number of farmers	9	14
- Number of sites	18	36
- Total area (ha)	69,20	96,32
Quality II		
- Range of bid prices (€/ha)	50 – 160 (Ø 108,64 ± 45,61)	60 – 250 (Ø 112,60 ± 58,39)
- Payments (€)	87,33 – 485,18 (Ø 277,81 ± 132,58)	86,85 – 540,42 (Ø 287,06 ± 147,90)
- Number of farmers	9	11
- Number of sites	11	15
- Total area (ha)	29,78	40,86

Source: own. Ø = mean; ± = standard deviation.

Similar to the original case-study, the wide ranges and standard deviations of bid-prices – within both auctions and for both ecological quality classifications – point out differences of farmers' opportunity cost for the provision of floristic species richness on managed grassland sites. Within currently used flat-rate payment schemes these differences of opportunity costs would have remained unknown to the conservation agency and could, therefore, not have been taken into account while conservation contracting.

The price level (the mean bid-price) of the successful bids for the quality I grassland sites declined from the first to the second auction by €6.58 or 10.12 per cent, respectively. Since there

was no clear guideline for the event of more successful bids than money available, a special approach was applied for quality I grassland sites in the second auction. Without using this kind of approach, all sites with bid-prices of €100 per hectare would not have been accepted. In this case, however, about €1,800 of the specific budget would have remained unused. In order to spend the whole budget for the provision of plant biodiversity, these farmers were offered either not to be paid for the specific grassland sites or to accept a payment of €71.41 per hectare (by subdividing the remaining budget equally). This approach was accepted by all farmers. For the highest quality grassland sites, the price-level (the mean bid-price) slightly increased from the 2007 auction to the 2008 auction by €3.96 (3.65 per cent). Thereby it would have generally been possible to use a reserve price (an internal price limit) to avoid an increase in prices. However, due to its small extend, the auction design has not been changed and this increase in prices was accepted.

Due to different sizes of grassland sites and differences in bid-prices, the payments per bid (per grasslands site) vary greatly. The mean payment for the quality I grassland sites – for example – decreased from the first auction to the 2008 auction by €90.50 (36.39 per cent), mainly because both the price-level and the size of the grassland sites decreased in the second auction.

In the 2007 auction, a budget of €4,475.98 has been spent for quality I grassland sites and €3,055.87 have been spent for quality II grassland sites. Within the second auction, the total payments summed up to €5,694.04 for quality I grassland sites (+ 27.21 per cent). For quality II grassland sites, a budget of €4,305.89 (+ 40.91 per cent) has been spent in the 2008 auction. Thereby, the total area of rewarded species rich grassland sites increased from the first to the second auction by 27.12 hectare (39.19 per cent) for quality I grassland sites and by 11.08 hectare (37.21 per cent) for quality II grassland sites.

4.2.3 Cost-effectiveness gains

Besides the analysis concerning bids and bid-prices per hectare, the paper will now discuss the potential for cost-effectiveness gains by auctioning compared to flat-rate payments. For that purpose it is important to remember that the opportunity cost curve is the relevant supply curve when a flat-rate payment is offered. All landowners with opportunity costs below the fixed payment gain from participation in the payment scheme. The marginal participant is the one whose opportunity cost is equal to the payment rate offered. Under a discriminatory-price auction, the ordered bid-prices – not the opportunity cost curve – represent the supply curve. The

auction, therefore, creates incentives for landowners to shade their bids above their true opportunity costs and thereby to secure themselves an information rent. The cost-effectiveness of auctioning thus depends on the degree of bid shading. One would normally expect bid shading to be low and the auction to be superior to the flat-rate payment scheme. However, if bidders are able take into account results from previous auctions, bid shading can result in poor auction performance.

An evaluation of cost-effectiveness gains of auctioning compared to flat-rate payment schemes, therefore, should be done against a supply curve reflecting true marginal costs. An auction does reveal differences in opportunity costs, but only imperfectly so. Because of incentive to overbid, the true opportunity costs could not be identified within the case-study and remain subject to asymmetric information – and thus unknown to the author – in any field experiment. An appropriate comparison of the auction performance and a flat-rate payment scheme thus is difficult, based on data generated by field experiments. A precise comparison requires the use of laboratory experiments where the true marginal costs are perfectly controlled for and known to the experimenter. These limitations should be considered for the remainder of the section.

In order to discuss the specific potential for cost-effectiveness gains as part of the case-study, the successful bids will be compared to a flat-rate payment scheme using an equivalent payment-by-results approach. Since there is not yet a payment-by-results approach implemented within agri-environmental programmes in the federal state of Schleswig-Holstein, the Lower Saxony and Bremen agri-environmental programme 'Measure B2: support of species-rich grassland sites based on a payment-by-results approach' (Lower Saxony Ministry of Food, Agriculture, Consumer Protection and Rural Development, 2008) and the Lower Saxony programme 'Cooperative conservation programme - permanent grassland, payment-by-results' (Lower Saxony Ministry of Environment and Climate Change, 2007) are used as benchmarks. Within the (combined) benchmark programmes the same ecological quality classifications are used as in the case-study conservation procurement auctions – in this case they are called 'premium I' and 'premium II'. Thereby farmers receive a flat-rate payment of €110 per hectare for the quality classification premium I (as part of 'Measure B2: support of species-rich grassland sites based on a payment-by-results approach') and a flat-rate payment of €215 per hectare for premium II (€110 as part of the 'Measure B2: support of species-rich grassland sites based on a payment-by-

results approach' and additionally €105 per hectare as part of the 'Cooperative conservation programme - permanent grassland, payment-by-results').

Thus this comparison is currently – despite all unavoidable empirical inaccuracy mentioned above – the most meaningful way to learn about the potential for cost-effectiveness gains in practice, based on the available data from field experiment conservation procurement auctions. Main results concerning the potential for cost-effectiveness gains by the case-study conservation procurement are presented in table 5.

Table 5: Potential for cost-effectiveness gains within both case-study auctions

	Auction 2007	**Auction 2008**
Quality I		
- Range of bid prices (€/ha)	30 – 100 (Ø 65,00 ± 21,49)	30 – 80 (Ø 58,42 ± 13,62)
- Flat-rate payment B2 (€/ha)	110	110
- Total area (ha)	69,20	96,32
- Sum of payments (€)	4.475,98	5.694,04
- Required budget B2 (€)	7.612,00	10.595,20
- Cost-effectiveness gains (€ | %)	3.136,02 | 41,20	4.901,16 | 46,25
Quality II		
- Range of bid prices (€/ha)	50 – 160 (Ø 108,64 ± 45,61)	60 – 250 (Ø 112,60 ± 58,39)
- Flat-rate payment B2+Co (€/ha)	215	215
- Total area (ha)	29,78	40,86
- Sum of payments (€)	3.055,87	4.305,89
- Required budget B2+Co (€)	6.402,70	8.784,90
- Cost-effectiveness gains (€ | %)	3.346,83 | 52,27	4.479,01 | 50,99

Source: own. Ø = mean; ± = standard deviation.

Results of benchmarking the auction performance with the flat-rate payment scheme – by comparing the budget spent within the auctions and the budget that would have been required to take the same area of grassland sites under contract by using the flat-rate payment ('required budget B2 (€)' or 'required budget B2+Co (€)', respectively) – point out a potential for cost-effectiveness gains for both quality classifications in both auctions.

Within the first auction – for example – 69.20 hectare quality I grassland sites have been taken under contract and have finally been rewarded with a budget of €4,475.98. To take the same area under contract by using the flat-rate payment of €110 per hectare, a budget of €7,612.00 would have been required instead. Thus, the results point out a potential for cost-effectiveness gains by auctioning of €3,136.02 (41.2 per cent). For the successful quality II grassland sites, the results from the 2007 auction highlight a potential for cost-effectiveness gains of €3,346.83 (52.27 per

cent). A potential for cost-effectiveness gains of €4,901.16 (46.25 per cent) has been obtained for quality I grassland sites in the 2008 auction. For quality II grassland sites the potential for cost-effectiveness gains sums up to €4.479.01 (50.99 per cent) in the second auction.

5 Conclusion

In current European agri-environmental payment programmes, the conservation agency knows less than landowners know about the individual costs of contractual compliance. Hence, landowners may use their private information to extract informational rents. Reducing informational rents, therefore, is an important task for buyers of environmental services who wish to maximize the services obtained from a limited budget. As agri-environmental agencies look for better ways of contracting landowners for the provisions of ecological services, some clear conclusions emerge from this case-study on conservation procurement auctions and a payment-by-results approach. First of all, it becomes clear that it was possible to transfer the original case-study payment scheme successfully to another region, whereby four adjustments had been conducted (section 4.1).

The results of both auctions within the adapted case-study point out much differentiated bid-prices and the fact that all main objectives of auctioning (budgetary cost-effectiveness and the possibility to gather information about the production costs of agricultural firms) were fulfilled.

Even if the auctioning scheme is a comparatively simple case-study, the results are sufficient to point out a potential for cost-effectiveness gains by auctioning compared to traditional flat-rate payments in environmental and biodiversity conservation policy. Therefore – and with regard to international economic aspects of biodiversity protection – this case-study is another proof of how promising market-based approaches are. Keeping in mind the methodological difficulties of evaluating field experiments, the empirical work indicates budgetary-cost advantages of auctioning in comparison to flat-rate payment schemes in the range of 41 to 50 per cent. Hence, the adapted case-study even outperforms the original case-study.

These findings as well as a relative high number of participants point out that this specific approach also became popular with landowner in another German region and that the topic of biodiversity conservation turned from a primary complex and somewhat diffuse idea to practical actions and monetary incentives for farmers.

As already mentioned, the reported results of cost-effectiveness gains by auctioning compared to flat-rate payments vary greatly (section 2.3). However, the results of this adapted case-study fit

well with cost-effectiveness gains reported for the Central Scotland Forest and Grampian Challenge Fund (CJC Consulting, 2004), the Catchment Care Program in Australia (National Market Based Instruments Working Group, 2005) and the original German case-study (Groth, 2007; Groth, 2008a).

Even if conservation procurement auctions are an imperfect revelation mechanism, it will most probably be an improvement over current flat-rate payments, because low-cost producers gain smaller information rents and the conservation agency will – with the same given budget – be able to close contracts with (some) high-cost farmers due to cost-effectiveness gains provided by low-cost landowners.

Despite the potential of combining a payment-by-results approach for floristic biodiversity and the use of conservation procurement auctions, it needs to be considered that the implementation of conservation auctions into European agri-environmental programmes is – at present – not in sight. This lack of political enforceability is particularly caused by that fact that implementing and running conservation auctions in practice is far from being trivial and more empirical and evaluative work is needed in this area. I would like briefly, therefore, to address what I believe to be three areas where further research currently is needed in the field of conservation procurement auctions.

Firstly, there should be a worldwide evaluation of recent attempts of practical implementations of conservation procurement auctions, based on a review of the current literature as well as on surveys (written questionnaires and face-to-face interviews). The aim should be to learn about the performance of specific auctions in various countries from ecological, economic and political perspectives. Critical factors for success as well as requirements for the design of upcoming conservation auctions should be deduced and made available to policy makers.

Secondly, the question of how the auctioneer (the conservation agency) should deal with information about the offered environmental services needs to be considered. The fact that conservation procurement auctions are usually repeated auctions allows not only bidders to learn from the results of previous auctions, but also the conservation agency. An important question, therefore, is how the agency should deal with information about hitherto successful sites from a former auction, offered again in a subsequent auction, as well as new bids for as yet unknown sites. Thus, there is a fundamental need for research on how the agency should handle information on offered services, for example the extent to which the provision of biodiversity in

the previous period is a significant determinant of current period biodiversity (the relevance of ecological stock dynamics).

Thirdly, a promising approach to valuing the ecological quality of offered sites and meeting the practical requirements of most conservation auctions is the use of an environmental benefits index. Hence, current research should deal with the definition and design of a specific environmental benefits index for plant biodiversity. This index needs to combine economic, ecological and social criteria in order to facilitate a differentiated bid valuation within repeated conservation procurement auctions.

I also like to encourage the implementation of transdisciplinary case-studies, bringing together scientists and those actors who are actually familiar in practice with designing and receiving payments for environmental services. I strongly believe that we should talk more about real changes in the institutions governing the way landowners are paid in order to develop a cost-effective and sustainable future European agri-environmental policy. Fewer regulations and more – well considered – market creation by a combined use of conservation procurement auctions and a payment-by-results approach would seem to be a substantial step in the right direction.

Acknowledgement

The adapted case-study was established and carried out by the Conservation Foundation Schleswig-Holstein and the Farmers Union Steinburg. I like to mention that I am grateful to the Conservation Foundation Schleswig-Holstein for the possibility to use the data from the case-study for this paper. Thereby, I especially like to thank Tobias Meier for patiently answering my questions and providing me with further information on the payment scheme. My thanks also go to colleagues who have commented on earlier drafts of this paper. Any remaining errors are solely my responsibility.

References

Babcock, B., Lakshminarayan, P. G., Wu, J. and Zilberman, D. (1996), The economics of a public fund for environmental amenities: a study of CRP contracts, American Journal of Agricultural Economics 78, 961-971.

Balmford, A., Bennun, L., Brink, B. T., Cooper, D., Côte, I. M., Crane, P., Dobson, A., Dudley, N., Dutton, I., Green, R. E., Gregory, R. D., Harrison, J., Kennedy, E. T., Kremen, C., Leader-Williams, N., Lovejoy, T. E., Mace, G., May, R., Mayaux, P., Morling, P.,

Phillips, J., Redford, K., Ricketts, T. H., Rodriguez, J.P., Sanjayan, M., Schei, P. J., van Jaarsveld, A. S. and Walther, B. A. (2005), The Convention on Biological Diversity's 2010 Target, Science 307, 212–213.

Balvanera, P, Daily, G. C., Ehrlich, P. R., Ricketts, T. H., Bailey, S-A., Kark, S., Kremen, C. and Pereira, H. (2001), Conserving biodiversity and ecosystem services, Science 291, 2047.

Balvanera, P., Pfisterer, A. B., Buchmann, N., He, J-S., Nakashizuka, T., Raffaelli, D. and Schmid, B. (2006), Quantifying the evidence for biodiversity effects on ecosystem functioning and services, Ecology Letters 9, 1146-1156.

Bertke, E. (2005), Ökologische Güter in einem ergebnisorientierten Honorierungssystem für ökologische Leistungen der Landwirtschaft. Herleitung - Definition - Kontrolle. Diss. Göttingen, Stuttgart 2005.

Cason, T., Gangadharan, L. and Duke, C. (2003), A laboratory study of auctions for reducing non-point source pollution, Journal of Environmental Economics and Management 46, 446-471.

Cason, T. and Gangadharan, L. (2004), Auction design for voluntary conservation programs, American Journal of Agricultural Economics 86, 1211-1217.

Cason, T. and Gangadharan, L. (2005), A laboratory comparison of uniform and discriminative price auctions for reducing non-point source pollution, Land Economics 81, 55-70.

Chan, C., Laplagne, P. and Appels, D. (2003), The role of auctions in allocating public resources. Productivity Commission Staff Research Paper, Productivity Commission, Melbourne, Australia.

Chapin III, F. S., Zavaleta, E. S., Eviner, V. T., Naylor, R. L., Vitousek, P. M., Reynolds, H. L., Hooper, D. U., Lavorel, S., Sala, O. E., Hobbie, S. E., Mack, M. C. and Diaz, S. (2000), Consequences of changing biodiversity, Nature 405, 234-242.

CJC Consulting (2004), Economic Evaluation of the Central Scotland Forest and Grampian Challange Funds. Final report for Forestry Commission Scotland, Oxford, Aberdeen.

Claassen, R., Cattaneo, A. and Johansson, R. (2008), Cost-effective design of agri-environmental payment programs: U.S. experience in theory and practice, Ecological Economics 65, 737-752.

Cummings, R. G, Holt, C. A. and Laury, S. K. (2004), Using laboratory experiments for policymaking: an example from the Georgia Irrigation Reduction Auction. Journal of Policy Analysis and Management 23 (2), 341–363.

Drechsler, M., Wätzold, F., Johst, K., Bergmann, H. and Settele, J. (2007), A model-based approach for designing cost-effective compensation payments for conservation of endangered species in real landscapes, Biological Conservation 140, 174-186.

Egoh, B., Rouget, M., Reyers, B., Knight, A. T., Cowling, R. M., van Jaarsveld, A. S. and Welz, A. (2007), Integrating ecosystem services into conservation assessments: A review, Ecological Economics 63, 714-721.

Ferraro, P. J. and Kiss, A. (2002), Direct payments to conserve biodiversity, Science 298, 1718-1719.

Ferraro, P. J. (2008), Asymmetric information and contract design for payments for environmental services, Ecological Economics 65, 810-821.

Fraser, I. M. (1995), An analysis of management agreement bargaining under asymmetric information, Journal of Agricultural Economics 46, 20–32.

Groth, M. (2007), Ausschreibungen in der Agrarumweltpolitik: Konzeption und Ergebnisse der praktischen Umsetzung eines Modellvorhabens, Perspektiven der Wirtschaftspolitik 8 (3), 279-292.

Groth, M. (2008a), An empirical examination of repeated auctions for biodiversity conservation contracts. University of Lüneburg Working Paper Series in Economics, Working Paper No. 78, March 2008.

Groth, M. (2008b), Private ex-ante transaction costs for repeated biodiversity conservation auctions: a case study. University of Lüneburg Working Paper Series in Economics, Working Paper No. 84, May 2008.

Gerowitt, B., Isselstein, J. and Marggraf, R. (2003), Rewards for ecological goods – requirements and perspectives for agriculture land use, Agriculture, Ecosystems and Environment 98, 541-547.

Grafton, Q. (2005), Evaluation of round one of the market based instruments pilot program: http://www.napswq.gov.au/publications/books/mbi/pubs/round1-evaluation.pdf (22. December 2008).

Hailu, A. and Thoyer, S. (2006), Multi-unit auction format design, Journal of Economic Interaction and Coordination, 129-146.

Hilden, R. (2007), Ausschreibung als ökonomisches Instrument zur Ausgestaltung von Agrarumweltprogrammen – Analyse am Beispiel der Grünlandextensivierung von Nordrhein – Westfalen. Diss. Culliver Verlag, Göttingen.

Jackson, L. E., Pascual, U. and Hodgkin, T. (2007), Utilizing and conserving agrobiodiversity in agricultural landscapes, Agriculture, Ecosystems and Environment 121, 196-210.

Jehiel, P. and Moldovanu, B. (2003), An economic perspective on auctions, Economic Policy 36, 271-308.

Kagel, J. and Levin, D. (2001), Behavior in multi-unit demand auctions: experiments with uniform price and dynamic Vickrey auctions, Econometrica 69, 413-454.

Kleijn, D. and Sutherland, W. J. (2003), How effective are European agri-environment schemes in conserving and promoting biodiversity?, Journal of Applied Ecology 40, 947-969.

Kleijn, D., Baquero, R. A., Clough, Y., Díaz, M., De Esteban, J., Fernández, F., Gabriel, D., Herzog, F., Holzschuh, A., Jöhl, R., Knop, E., Kruess, A., Marshall, E. J. P., Steffan-Dewenter, I., Tscharntke, T., Verhulst, J., West, T. M. and Yela, J. L. (2006), Mixed biodiversity benefits of agri-environment schemes in five European countries, Ecology Letters 9, 243-254.

Klemperer, P. (1999), Auction theory: a guide to the literature, Journal of Economic Surveys 13, 227-286.

Klemperer, P. (2002), What really matters in auction design, Journal of Economic Perspectives 16, 169-190.

Klimek, S., Richter gen. Kemmermann, A., Steinmann, H. H., Freese, J. and Isselstein, J. (2008), Rewarding farmers for delivering vascular plant diversity in managed grasslands: A transdisciplinary case-study approach, in Biological Conservation 141 (11), 2888-2897.

Krishna, V. (2002), Auction theory. Academic Press, Elsevier Science, San Diego.

Kroeger, T. and Casey, F. (2007), An assessment of market-based approaches to providing ecosystem services on agricultural lands, Ecological Economics 64, 321-332.

Latacz-Lohmann, U. and Van der Hamsvoort, C. (1997), Auctioning conservation contracts: a theoretical analysis and an application, American Journal of Agricultural Economics 79, 407-418.

Latacz-Lohmann, U. and Van der Hamsvoort, C. (1998), Auctions as a means of creating a market for public goods from agriculture, Journal of Agricultural Economics 49, 334-345.

Latacz-Lohmann, U. and Schilizzi, S. (2005), Auctions for conservation contracts: a review of the theoretical and empirical literature. Report to the Scottish Executive Environment and Rural Affairs Department: http://www.scotland.gov.uk/Ressource/Doc/93853/0022574.pdf (12. November 2008).

Lower Saxony Ministry of Environment and Climate Change (2007), Cooperative conservation programme - permanent grassland, payment-by-results [*Niedersächsisches Ministerium für Umwelt und Klimaschutz (2007), Kooperationsprogramm Naturschutz Dauergrünland – ergebnisorientiert*]: http://cdl.niedersachsen.de/blob/images/C44063153_L20.pdf (13. December 2008).

Lower Saxony Ministry of Food, Agriculture, Consumer Protection and Rural Development (2008), Measure B2: support of species-rich grassland sites based on a payment-by-results approach [*Niedersächsische Ministerium für Ernährung, Landwirtschaft, Verbraucherschutz und Landesentwicklung (2008), B2 - extensive Grünlandnutzung nach dem Prinzip der ergebnisorientierten Honorierung*]: http://www.ml.niedersachsen.de/master/C32974510_N24979051_L20_D0_I655.html (13. December 2008).

Lowell, K., Drohan, J., Hajek, C., Beverly, C. and Lee, M. (2007), A science-driven market-based instrument for determining the cost of environmental services: A comparison of two catchments in Australia, Ecological Economics 64, 61-69.

McKee, M. and Berrens, R. P. (2001), Balancing army and endangered species concerns: Green vs. Green. Environmental Management 27 (1), 123–133.

MEA (2005), Ecosystems and Human Well-being: Biodiversity Synthesis. Millennium Ecosystem Assessment World Resources Institute, Washington, DC.

Milgrom, P. (1989), Auctions and biding: a primer, Journal of Economic Perspectives 3, 3-22.

Milgrom, P. (2004). Putting Auction Theory to Work. Cambridge University Press, Cambridge UK.

Musters, C. J. M., Kruk, M., De Graaf, H. J. and Ter Keurs, W. J. (2001), Breeding birds as a farm product, Conservation Biology 15, 363-369.

Naidoo, R., Balmford, A., Ferraro, P. J., Polasky, S., Ricketts T. H. and Rouget, M. (2006), Integrating economic costs into conservation planning, Trends in Ecology and Evolution 21, 681-687.

National Market Based Instruments Working Group (2005), National market based instruments pilot program: round one. An interim report by the national market based instruments working group: http://www.napswq.gov.au/publications/books/mbi/pubs/round1-interim-report.pdf (07. September 2008).

Öckinger, E. and Smith, H. G., (2007), Semi-natural grasslands as population sources for pollinating insects in agricultural landscapes, Journal of Applied Ecology 44, 50-59.

Pascual, U. and Perrings, C. (2007), Developing incentives and economic mechanisms for in situ biodiversity conservation in agricultural landscapes, Agriculture, Ecosystems and Environment 121, 256-268.

Reichelderfer, K. and Boggess, J. (1988), Government decision making and program performance: the case of the conservation reserve program, American Journal of Agricultural Economics 70, 1-11.

Riley, J. G. and Samuelson, W. F. (1981), Optimal auctions. American Economic Review 71, 381–392.

Sala, O. E. and Peruelo, J. M. (1997), Ecosystem services in grasslands, in Daily, G. (Eds.), Nature´s services: societal dependence on natural ecosystems. Island Press, Washington DC, 237-252.

Schilizzi, S. and Latacz-Lohmann, U. (2007), Assessing the performance of conservation contracts: an experimental study, Land Economics 83, 497-515.

Stoneham, G., Chaudhri, V., Ha, A. and Strapazzon, L. (2003), Auctions for conservation contracts: an empirical examination of Victoria'a BushTender trial, The Australian Journal of Agricultural and Resource Economics 47, 477-500.

Sukhdev, P. et al. (2008), The economics of ecosystems & biodiversity (TEEB). An interim report: http://ec.europa.eu/environment/nature/biodiversity/economics/pdf/teeb_report.pdf (11. September 2008).

Von Haaren, C. and Bathke, M. (2007), Integrated landscape planning and remuneration of agri-environmental services: Results of a case study in the Fuhrberg region of Germany, Journal of Environmental Management 89, 209-221.

Voß, K. and Jödicke, K. (2006), Erfolgsorientierte Honorierung ökologischer Leistungen im Grünland im Rahmen des Pilotprojektes „Blühendes Steinburg". Endbericht. Kiel.

White, M. and Burton, M. P. (2005), Estimates of administrative and allocative efficiency of the Auction for Landscape Recovery. Provisional Report for the National Market Based Instruments Pilot Program.

Whitfield, J. (2006), How green was my subsidy?, Nature 439, 908-909.

Wittig, B., Richter gen. Kemmermann, A. and Zacharias, D. (2006), An indicator species approach for result-orientated subsidies of ecological services in grasslands – A study in Northwestern Germany, Biological Conservation 133, 186-197.

Wu, J. and Babcock, B. A. (1996), Contract design for the purchase of environmental goods from agriculture, American Journal of Agricultural Economics 78, 935-945.

Zechmeister, H. G., Schmitzberger, I., Steurer, B., Peterseil, J. and Wrbka, T. (2003), The influence of land-use practices and economics on plant species richness in meadows, Biological Conservation 114, 165-177.

Working Paper Series in Economics

(recent issues)

No.118: *Anja Klaubert:* Being religious – A Question of Incentives? February 2009

No.117: *Sourafel Girma, Holger Görg and Joachim Wagner:* Subsidies and Exports in Germany. First Evidence from Enterprise Panel Data, January 2009

No.116: *Alexander Vogel und Joachim Wagner:* Import, Export und Produktivität in niedersächsischen Unternehmen des Verarbeitenden Gewerbes, Januar 2009

No.115: *Nils Braakmann and Joachim Wagner:* Product Differentiation and Profitability in German Manufacturing Firms, January 2009

No.114: *Franziska Boneberg:* Die Drittelmitbestimmungslücke im Dienstleistungssektor: Ausmaß und Bestimmungsgründe, Januar 2009

No.113: *Institut für Volkswirtschaftslehre:* Forschungsbericht 2008, Januar 2009

No.112: *Nils Braakmann:* The role of psychological traits and the gender gap in full-time employment and wages: Evidence from Germany. January 2009

No.111: *Alexander Vogel:* Exporter Performance in the German Business Services Sector: First Evidence from the Services Statistics Panel. January 2009

No.110: *Joachim Wagner:* Wer wird subventioniert? Subventionen in deutschen Industrieunternehmen 1999 – 2006. Januar 2009

No.109: *Martin F. Quaas, Stefan Baumgärtner, Sandra Derissen, and Sebastian Strunz:* Institutions and preferences determine resilience of ecological-economic systems. December 2008

No.108: *Maik Heinemann:* Messung und Darstellung von Ungleichheit. November 2008

No.107: *Claus Schnabel & Joachim Wagner:* Union Membership and Age: The inverted U-shape hypothesis under test. November 2008

No.106: *Alexander Vogel & Joachim Wagner:* Higher Productivity in Importing German Manufacturing Firms: Self-selection, Learning from Importing, or Both? November 2008

No.105: *Markus Groth:* Kosteneffizienter und effektiver Biodiversitätsschutz durch Ausschreibungen und eine ergebnisorientierte Honorierung: Das Modellprojekt „Blühendes Steinburg“. November 2008

No.104: *Alexander Vogel & Joachim Wagner:* Export, Import und Produktivität wissensintensiver KMUs in Deutschland. Oktober 2008

No.103: *Christiane Clemens & Maik Heinemann:* On Entrepreneurial Risk – Taking and the Macroeconomic Effects Of Financial Constraints, October 2008

No.102: *Helmut Fryges & Joachim Wagner*: Exports and Profitability – First Evidence for German Manufacturing Firms. October 2008

No.101: *Heike Wetzel*: Productivity Growth in European Railways: Technological Progress, Efficiency Change and Scale Effects. October 2008

No.100: *Henry Sabrowsk*i: Inflation Expectation Formation of German Consumers: Rational or Adaptive? October 2008

No.99: *Joachim Wagner*: Produktdifferenzierung in deutschen Industrieunternehmen 1995 – 2004: Ausmaß und Bestimmungsgründe, Oktober 2008

No.98: *Jan Kranich:* Agglomeration, vertical specialization, and the strength of industrial linkages, September 2008

No.97: *Joachim Wagner:* Exports and firm characteristics - First evidence from Fractional Probit Panel Estimates, August 2008

No.96: *Nils Braakmann:* The smoking wage penalty in the United Kingdom: Regression and matching evidence from the British Household Panel Survey, August 2008

No.95: *Joachim Wagner:* Exportaktivitäten und Rendite in niedersächsischen Industrieunternehmen, August 2008
[publiziert in: Statistische Monatshefte Niedersachsen 62 (2008), 10,552-560]

No.94: *Joachim Wagner:* Wirken sich Exportaktivitäten positiv auf die Rendite von deutschen Industrieunternehmen aus?, August 2008
[publiziert in: Wirtschaftsdienst, 88 (2008) 10, 690-696]

No.93: *Claus Schnabel & Joachim Wagner:* The aging of the unions in West Germany, 1980-2006, August 2008
[forthcoming in: Jahrbücher für Nationalökonomie und Statistik]

No.92: *Alexander Vogel and Stefan Dittrich:* The German turnover tax statistics panels, August 2008
[published in: Schmollers Jahrbuch 128 (2008), 4, 661-670]

No.91: *Nils Braakmann:* Crime does pay (at least when it's violent!) – On the compensating wage differentials of high regional crime levels, July 2008

No.90: *Nils Braakmann:* Fields of training, plant characteristics and the gender wage gap in entry wages among skilled workers – Evidence from German administrative data, July 2008

No.89: *Alexander Vogel:* Exports productivity in the German business services sector: First evidence from the Turnover Tax Statistics panel, July 2008

No.88: *Joachim Wagner:* Improvements and future challenges for the research infrastructure in the field *Firm Level Data*, June 2008

No.87: *Markus Groth:* A review of the German mandatory deposit for one-way drinks packaging and drinks packaging taxes in Europe, June 2008

No.86: *Heike Wetzel:* European railway deregulation. The influence of regulatory ans environmental conditions on efficiency, May 2008

No.85: *Nils Braakmann:* Non scholae, sed vitae discimus! - The importance of fields of study for the gender wage gap among German university graduates during market entry and the first years of their careers, May 2008

No.84: *Markus Groth:* Private ex-ante transaction costs for repeated biodiversity conservation auctions: A case study, May 2008

No.83: *Jan Kranich:* R&D and the agglomeration of industries, April 2008

No.82: *Alexander Vogel:* Zur Exporttätigkeit unternehmensnaher Dienstleister in Niedersachsen - Erste Ergebnisse zu Export und Produktivität auf Basis des Umsatzsteuerstatistikpanels, April 2008

No.81: *Joachim Wagner:* Exporte und Firmenerfolg: Welche Firmen profitieren wie vom internationalen Handel?, März 2008

No.80: *Stefan Baumgärtner:* Managing increasing environmental risks through agro-biodiversity and agri-environmental policies, March 2008

No.79: *Thomas Huth:* Die Quantitätstheorie des Geldes – Eine keynesianische Reformulierung, März 2008

No.78: *Markus Groth:* An empirical examination of repeated auctions for biodiversity conservation contracts, March 2008

No.77: *Nils Braakmann:* Intra-firm wage inequality and firm performance – First evidence from German linked employer-employee-data, February 2008

No.76: *Markus Groth*: Perspektiven der Nutzung von Methanhydraten als Energieträger – Eine Bestandsaufnahme, Februar 2008

No.75: *Stefan Baumgärtner, Christian Becker, Karin Frank, Birgit Müller & Christian Quaas:* Relating the philosophy and practice of ecological economics. The role of concepts, models, and case studies in inter- and transdisciplinary sustainability research, January 2008
[publisched in: Ecological Economics 67 (2008), 3 , 384-393]

No.74: *Thorsten Schank, Claus Schnabel & Joachim Wagner:* Higher wages in exporting firms: Self-selection, export effect, or both? First evidence from German linked employer-employee data, January 2008

No.73: *Institut für Volkswirtschaftslehre:* Forschungsbericht 2007, Januar 2008

No.72: *Christian Growitsch and Heike Wetzel:Testing for* economies of scope in European railways: An efficiency analysis, December 2007
[revised version of Working Paper No. 29,
forthcoming in: Journal of Transport Economics and Policy]

No.71: *Joachim Wagner, Lena Koller and Claus Schnabel:* Sind mittelständische Betriebe der Jobmotor der deutschen Wirtschaft?, Dezember 2007
[publiziert in: Wirtschftsdienst 88 (2008), 2, 130-135]

No.70: *Nils Braakmann:* Islamistic terror, the war on Iraq and the job prospects of Arab men in Britain: Does a country's direct involvement matter?, December 2007

No.69: *Maik Heinemann:* E-stability and stability learning in models with asymmetric information, December 2007

No.68: *Joachim Wagner:* Exporte und Produktivität in Industriebetrieben – Niedersachsen im interregionalen und internationalen Vergleich, Dezember 2007

No.67: *Stefan Baumgärtner and Martin F. Quaas:* Ecological-economic viability as a criterion of strong sustainability under uncertainty, November 2007

No.66: *Kathrin Michael:* Überbrückungsgeld und Existenzgründungszuschuss – Ergebnisse einer schriftlichen Befragung drei Jahre nach Gründungsbeginn, November 2007

No.65: *The International Study Group on Export and Productivity:* Exports and Productivity – Comparable Evidence for 14 Countries, November 2007
[forthcoming in: Review of World Economics 144 (2008), 4]

No.64: *Lena Koller, Claus Schnabel und Joachim Wagner:* Freistellung von Betriebsräten – Eine Beschäftigungsbremse?, November 2007
[publiziert in: Zeitschrift für Arbeitsmarktforschung, 41 (2008), 2/3, 305-326]

No.63: *Anne-Kathrin Last:* The Monetary Value of Cultural Goods: A Contingent Valuation Study of the Municipal Supply of Cultural Goods in Lueneburg, Germany, October 2007

(see www.leuphana.de/vwl/papers for a complete list)

Leuphana Universität Lüneburg
Institut für Volkswirtschaftslehre
Postfach 2440
D-21314 Lüneburg
Tel.: ++49 4131 677 2321
email: brodt@leuphana.de
www.leuphana.de/vwl/papers