The use of markets for biodiversity in Germany: where are we and where should we go from here? [1]

Markus Groth
Leuphana University of Lueneburg
Sustainability Economics Group
Scharnhorststr. 1
D-21335 Lueneburg
Email.: groth@uni-lueneburg.de

Abstract

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. However, there is still a serve shortage of knowledge and practical experiences concerning the use of conservation procurement auctions in Europe.

The aim of the paper, therefore, is twofold. Firstly, the current state of using markets for biodiversity by means of payment-by-results biodiversity conservation procurement auctions will be discussed by reviewing two field experiments with farmers in two case-study areas in Germany. Secondly, further need for research will be discussed briefly.

Keeping in mind the methodological difficulties of evaluating field experiments, this empirical work indicates a potential for budgetary cost advantages of auctioning compared to traditional fixed flat-rate payment schemes of up to 52 per cent. These findings along with the relatively high number of successful participants indicate that this specific approach will most probably be an improvement over current agri-environmental programmes in the EU. This is mainly because low-cost producers gain smaller information rents and conservation agencies will be able to close contracts with (some) high-cost farmers due to cost-effectiveness gains provided by low-cost landowners.

[1] Paper accepted for presentation as part of the 2010 Berlin Conference on the Human Dimensions of Global Environmental Change. This draft: 17.08.2010. Section five is based on joint work together with Franziska Dittmer; it highlights some first brief ideas from a still unpublished manuscript.

Even though the case-studies have yielded promising results, some critical aspects as well as lessons to be learnt will be discussed to improve the design and performance of upcoming biodiversity conservation procurement auctions based on performance payments. Current need for research addressed in the paper takes deals with the design of a specific agri-environment index for plant biodiversity.

Keywords: agri-environment index, agri-environmental policy, conservation procurement auctions, discriminatory-price auctions, ecological services, experimental economics, multi-unit auctions, payment-by-results, plant biodiversity, rural development.

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

1 Introduction

The United Nations proclaimed 2010 to be the International Year of Biodiversity. Europe's biodiversity currently faces a rapid loss within agricultural landscapes, which implies a decline of various ecosystem services that are of socio-economic value. Against this background, increasing attention is to be paid to farming practices that contribute to the maintenance and enhancement of biodiversity and ecosystem services. Therefore, the development of a cost-effective conservation-compatible land use policy to influence private land management is the main challenge currently facing EU agri-environmental policy. Thereby the protection of ecosystem services as well as the preservation of biodiversity plays a central role, both from an economic and ecological perspective (Balvanera et al., 2001; Balvanera et al., 2006; Jackson et al., 2007; MEA, 2005; Sala and Peruelo, 1997; Sukhdev et al., 2008).

In the 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; Kleijn and Sutherland, 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 has several potential advantages over the current schemes, as follows (Ferraro and Kiss, 2002; 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 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. In this context, 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 fixed flat-rate payment will not participate, due to missing incentives. This is mainly the case since in contractual relationships involving payments for environmental services, policy implementing authorities know less than each landowner about the costs of contractual compliance. Therefore landowners may use their private information to extract informational rents (Wu and Babcock, 1996; Latacz-Lohmann and Van der Hamsvoort, 1997; Cason et al., 2003; Stoneham et al., 2003; Cason and Gangadharan, 2004; Groth, 2007; Pascual and Perrings, 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 rather 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 for increasing policy cost-effectiveness is to strengthen 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 different bid-prices, and thus, improve policy efficacy.

The EU 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. However, there is still a significant 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. Since these case-studies have been limited to one region (county) there is also still a lack of clarity whether and how such payment schemes could be transferred to other regions. In an effort to portray the advantages of an alternative policy-implementation approach, this paper mainly 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. Furthermore, need for research addressed in the paper deals with the design of a specific agri-environment index for plant biodiversity in order to improve current payment-by–results biodiversity conservation procurement auctions.

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. Within the fifth section further need for research will be highlighted by discussing suggestions about how an agri-environment index can be designed by taking into account specific ecological and economical factors that reflect benefits and costs of biodiversity conservation. Section six concludes.

2 Conservation procurement auctions

2.1 Payment format and auction design

Auctions to buy ecological services from landowners 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; Cason et al., 2003; Stoneham et al., 2003; Cason and Gangadharan, 2004; Naidoo et al., 2006; 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, 2002; Krishna, 2002) 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 (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).

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 (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.

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. 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.

Auction outcomes are thus sensitive to the bidding rules and the characteristics of the contracts and bidders. Whether informational rents are actually higher under a uniform-price payment format or under a discriminatory-price payment format is obviously an empirical question and the choice between both payment formats is still controversial in practice.

2.2 Practical experiences and cost-effectiveness gains

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).

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 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 Auction for Landscape Recovery programme 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')[2]

3.1 Payment scheme and auction design

The original case-study conservation procurement auctions was 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 were rewarded as results 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 to protect regional endangered plant communities and to promote 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,

[2] 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).

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 were 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.

Landowners not exactly meeting the ecological requirements of the ecological good the bid targeted on were not 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 (Klimek et al., 2008)

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 was carried out in the time-period 2004/2005 and the second auction in 2006 (Groth, 2007; Groth, 2008a).

3.2 Results – auction performance

The results of the original case-study will now be presented briefly.[3] To participate in the case-study, landowners were allowed to submit an individual bid for each grassland site, whereas they were also allowed to submit several bids for all categories of ecological services. Main results of the **submitted bids** are presented in table 1.

Table 1 about here

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. Due to a budget-restriction of €30,000 not all bids in the total amount of €33,747.91 could have been 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 were covered.

Table 2 about here

The results clarify a wide range of individual bid-prices and thus the consequences of the discriminatory-price payment format for conservation contracting. 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

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

first to the second auction. This increase was caused by an adjustment of the subdividing of the total budget-restriction on the three categories of ecological goods in the second auction.

Finally the main results of the potential for **cost-effectiveness gains by auctioning compared to fixed flat-rate payments**[4] 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 potential for cost-effectiveness gains in practice). In the first auction 198.25 hectare were taken under contract, whereas the specific budget sums up to €16,100.84. To achieve the equivalent area by using a fixed flat-rate payment of €103 per hectare a total budget of €20,419.75 would have been required. 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 this positive appraisal. By using the fixed flat-rate payment of €103 per hectare, a budget of €13,395.15 would have been required to attain the ecological objective of 130.05 hectare grassland taken under contract in 2006. This objective was achieved by auctioning with a fee 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 adapted case-study also aimed to reward landowners for their voluntary provision of regional-specific plant biodiversity of environmental services in a cost-effective way. Therefore the number of species was taken into account and a first adjustment was conducted. For this purpose the former catalogue of 40 regional-specific species from the original case-study was 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 was implemented by using two and not three quality classifications. Thereby the payment-by-results approach was now based on the number of different species per segment on a representative transect and not based on different species per

[4] 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 a flat-rate payment of €103 per hectare within the agri-environmental programme.

representative control plots, like in the original case-study. This third adjustment was accomplished since 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 was carried out in 2007 and the second auction in 2008. Thereby a fourth adjustment was conducted. 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 aimed to reduce farmers' risk within the payment-by-results approach. Based on the results of on-the-spot controls, the grassland sites were classified as i) ineligible, ii) quality I or iii) quality II. The successful farmers were paid based on the results of the on-the-spot controls and according to the individual bid-prices for quality I or quality II.

The auction design in the adapted case-study was also a budget-constraint sealed-bid discriminatory-price conservation procurement auction. All farmers were allowed to take part in the field experiment auctions with their grassland sites located in the case-study area (the county Steinburg). In both auctions the same (potential) cohort of farmers participated in 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 were given to potential bidders in both auctions. The budget 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 were allowed to submit several bids for both ecological quality classifications. Thereby an individual bid had to be submitted for every grassland site. The 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 about here

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 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 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 paper will discuss the successful bids taken under contract and rewarded with the given budget. Thereby the compliance to requirements was verified by means of on-spot-controls until the end of June. Main results of the successful bids are presented in table 4.

Table 4 about here

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 policy implementing authority while conservation contracting.

The price level (the mean bid-price) of 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. 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. Compared to the 2007 auction, the mean payment for the quality I grassland sites in 2008 decreased by €90.50 (36.39 per cent), mainly because both the price-level and the size of the grassland sites decreased.

In the 2007 auction, €4,475.98 were spent for quality I grassland sites and €3,055.87 for quality II ones. Within the second auction, the total payment summed up to €5,694.04 for quality I grassland sites (+ 27.21 per cent) and €4,305.89 (+ 40.91 per cent) for quality II. Thereby the total area 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

The paper will now discuss the potential for cost-effectiveness gains by auctioning compared to fixed flat-rate payments. For that purpose it is important to remember that the opportunity cost curve is the relevant supply curve when a fixed 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.

An evaluation of cost-effectiveness gains of auctioning compared to fixed flat-rate payment schemes 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 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 are compared to a fixed 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 these (combined) benchmark programmes the same ecological quality classifications are used as in the case-study, but in this case they are termed 'premium I' and 'premium II'. Thereby farmers receive a fixed 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 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 about here

Results of benchmarking the auction performance with the fixed 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 fixed 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.

Indicatively, within the first auction 69.20 hectare quality I grassland sites were taken under contract and rewarded with a fee of €4,475.98. To take the same area under contract by using the fixed flat-rate payment of €110 per hectare, a budget of €7,612.00 would have been required. 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) was 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 Need for research – an agri-environment index (AEI)

5.1 Basic considerations

Even though current case-studies in Germany have yielded promising results, some critical aspects as well as lessons to be learnt should be discussed to improve the design and performance of upcoming biodiversity conservation procurement auctions based on performance payments. Accordingly, the leading question of this section is how an environmental benefits index can be designed to quantify the biodiversity conservation benefits and costs of a given investment option within a biodiversity conservation payment scheme.

In order to specify suggestions for the design of an AEI, the focus will lie on biodiversity conservation in grasslands. This specific habitat type is chosen for two main reasons. Grasslands are among the most biodiversity rich habitat types in Europe (EC, 2008) and the area of grasslands declines steadily (EC, 2008; BfN, 2009). Moreover, the conservation and recreation of semi-natural habitats (like grasslands) via the use of government incentives is politically intended, like for example by the German 'National Strategy on Biological Diversity' (BMU, 2007).

Two different environmental indices should be used as role models: the Environmental Benefits Index (EBI) as part of the Conservation Reserve Program in the United States (USDA, 2007; Claassen et al., 2008; Hajkowicz et al., 2009; USDA, 2009) and the Biodiversity Benefits Index (BBI) within the BushTender trial in Australia (Stoneham et al., 2003; Grafton, 2005; National

Market Based Instrument Working Group, 2005; DSE, 2008; DSE, 2009). These specific indices are chosen, because they are successfully approved in conservation payment schemes in the USA and Australia, and can provide relevant information for designing an AEI, although they do not particularly concentrate on biodiversity conservation in grassland habitats. Based on experiences from the EBI and the BBI, suggestions for the design of an AEI – considering its adoption in a payment scheme for biodiversity conservation in grasslands – will be discussed.

Before analysing which potential individual factors an AEI should contain, some pre-considerations have to be outlined. In order to design an AEI, it is first of all important upon which specific grassland types the payment scheme will concentrate on. Shall all grassland types be able to participate in the scheme? Or shall only so far extensively managed grassland types be able to participate, as recommended by Kleijn and Sutherland (2003). Further suggestions about the design of an AEI will be based on the assumption that species-poor intensive used grassland types and sowed grassland as well as miscellaneous pastures will be excluded from participation in a payment scheme. In this case it seems useful to determine specific criteria that can identify the target grassland types and exclude all other types from participation.

Former advantages and disadvantages have shown that a hybrid functional form (according to the BBI) – whereby several sub-factors are added up to build a main factor and the main factors are multiplied to get the benefits score – is practical and recommendable for calculating prospective conservation benefits. This approach gives each main benefit factor more weight than in a purely additive calculation (like in the EBI), because a poor performance in one main factor can not easily be compensated by a strong performance in another main factor. For that reason, the suggestion for the design of an AEI will be built upon this hybrid functional form.

The design of an AEI is dependent on the scheme configuration. Further suggestions about the AEI will be made on the basis of a payment scheme configuration using conservation procurement auctions with discriminatory payments.

5.2 First brief suggestions for the design of an AEI

According to the previous experiences, an AEI that can be adopted in a scheme for biodiversity conservation in German grasslands with discriminatory payments can be structured as follows. The general design of the AEI is suggested to be a benefits-to-costs ratio – conservation benefits as numerator and the costs as denominator – according to the BBI:

$$AEI = \frac{CSFxCFxCMF}{CostFactor}$$

Conservation Significance Factor (CSF): The CSF can be determined by the respective grassland type (ascertained due to a common vegetation classification) and its conservation significance – vulnerability degree of quantitative area decline and qualitative habitat alteration – according to the German red list of vulnerable habitat types.

Connectivity Factor (CF): The CF can be determined by a connectivity measure, like a buffer measure (e.g. similar to the approach of the neighbourhood analysis of Parkes et al. (2003)).

Conservation Management Factor (CMF): The CMF can be determined by a list that contains a broad range of management activities that serve for grassland biodiversity conservation. Each management activity is assigned a certain number of score points according to how effective this measure is estimated for maintaining or enhancing biodiversity conservation in grasslands. Additionally the years of former participation in a conservation scheme as well as the years of future contract obligations can be accounted in the CMF.

Cost Factor: The cost factor can be determined by taking the respective bid price per hectare (€/ha) of each applicant into account. Because there is no size factor in the numeration, an absolute measure like the full bid price cannot be used for an evaluation. Therefore a relative measure (e.g. costs per hectare) – like in the EBI will be suggested in this context.

Since species-poor intensively used grassland types as well as sowed grassland and miscellaneous pastures will be – within this example – excluded from scheme participation the payment scheme needs an approach to determine the threshold for participation. For this purpose the approach of using a pre-defined index list of flowering plant species to identify extensively managed and species-rich grassland should be adopted.

6 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 authorities designing and implementing agri-environmental policy measures in the EU look for better ways of contracting landowners for the provisions of ecological services, some rather useful 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 were conducted (see section 4.1).

The results of both auctions within this 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, results are sufficient to point out a potential for cost-effectiveness gains by auctioning compared to traditional fixed flat-rate payments in environmental and biodiversity conservation policy. Keeping in mind the methodological difficulties of evaluating field experiments, this empirical work indicates budgetary-cost advantages of auctioning in comparison to fixed 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. However, the results of this adapted case-study are in line 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 the 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.

Even though the case-studies have yielded promising results, some critical aspects as well as lessons to be learnt should be discussed to improve the design and performance of upcoming biodiversity conservation procurement auctions based on performance payments. This is mainly the case, since current case-studies used have been characterized by a simple bid-valuation without using something like an AEI. Mainly based on experiences from the Environmental Benefits Index and the Biodiversity Benefits Index, the recommended design of an AEI is as follows. The general structure should be a benefits-to-costs ratio with a quantification of the prospective benefits of a grassland site for biodiversity conservation in the numerator and a cost factor in the denominator. The evaluation of the benefits contains three factors: the Conservation Significance Factor (CSF), the Connectivity Factor (CF) and the Conservation Management Factor (CMF). The Cost Factor can be determined by taking the respective bid price per hectare (€/ha) that the applicant will demand as compensation payment for the conservation services.

There should be no doubt, that it is important to change the current practice of payment schemes for biodiversity conservation and to implement schemes that effectively induce incentives to maintain grassland sites that are of high conservation significance. An AEI seems to be a convenient instrument to identify applicants who can provide biodiversity conservation on high-quality grassland habitats at low costs and thus to allocate limited public funds in a cost-effective way. The here given first brief suggestions concerning the design of an AEI may be a contribution to further interdisciplinary discussion.

Therefore, I would also like to encourage the implementation of further inter- and 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

I am grateful to the Conservation Foundation Schleswig-Holstein for the possibility to use the data from the case-study for this paper. Any remaining errors are solely my responsibility.

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Table 1. Submitted bids within both auctions – main results

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		
- Range of prices in €/ha	40 – 250 (Ø 100.92; ± 47.18)	25 – 160 (Ø 93.94; ± 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; ± 59.55)	75 – 300 (Ø 147.67; ± 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; ± 78.73)	150 – 450 (Ø 257.35; ± 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

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

Table 2. Submitted bids within both auctions – main results

	1st auction (2004/2005)	2nd auction (2006)
Grassland I		
- Range of prices in €/ha	40 – 145 (Ø 84.59; ± 26.45)	25 – 90 (Ø 66.86; ± 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; ± 59.55)	75 – 200 (Ø 137.87; ± 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; ± 78.73)	150 – 450 (Ø 257.35; ± 89.34)
- Number of sites	18	23
- Hectare	36.98	31.61
- Number of farmers	8	7

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

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 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.

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.