Auctioning plant biodiversity – a promising new instrument within the European agri-environmental policy? Evidence from a case study

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Summary

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 introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts. The paper presents an evaluation of auctions with respect to ecological services in agrarian landscapes within a case study area in Germany. Results from two auctions show much differentiated bid prices and clarify the practical potential for a more efficient use of public funds by the use of auctions compared to fixed flat-rate payments. Furthermore a discussion of the farmers' transaction costs defined as the weighted time expenditure of the proposal preparation points out their comparative low relevance as well as a decrease from the first to the second auction.

Key words:

agri-environmental policy, auctions, ecological services, outcome orientation, plant biodiversity, transaction costs, experimental economics

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

1. Introduction

Since the reform of the Common Agricultural Policy (CAP) in 1992 agri-environmental schemes have been supported by the EU within the framework of the second pillar of the CAP. In this context it is the norm, that ecological services provided by agriculture are predominantly rewarded action-orientated and by the use of a single, fixed payment for compliance with a predetermined combination of management prescriptions. Even though the discussion concerning the use of economic instruments in environmental policy has already expanded in the 1990s, the diffusion of innovative policy design has been slow. Most states still had relied on regulatory, not on market-based policies and even though this strategy had yielded some success, it became clear that market-based strategies and instruments could be more effective for certain applications (Latacz-Lohmann and Hodge, 2003).

In the case of plant biodiversity in Europe the problem of increasingly endangered biodiversity is to a growing extent recognized, but the question of how to address this challenge appropriately has yet to be answered (Kleijn and Sutherland, 2003). So it is mainly the question to develop efficient and effective conservation-compatible land use policies to influence private land management.

One of the suggested approaches is the strengthening of incentive measures and market-creation. 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 introduced auctioning as a new instrument for granting agri-environmental payments and awarding conservation contracts for the current multi-annual budgetary plan (2007-2013): "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, in the range of policy options aimed at the conservation and protection of biological diversity, market-based instruments have only recently gained more attention. Therefore I focus on the specific mechanism of auctioning conservation contracts in biodiversity protection efforts and the paper sets out to investigate the "real-life performance" of repeated conservation auctions within a case study area in Germany.

Theoretically the potential benefit of auctions in allocating contracts is evident and well analysed by auction theory (Latacz-Lohmann and Van der Hamsvoort, 1997; 1998; Klemperer, 1999; 2002; Krishna, 2002; Jehiel and Moldovanu, 2003). The two main reasons why auctions are of interests in this case are: first, the traded ecological goods are non-market

goods which have no standard value and in some kind of way a public demand and valuation is needed. The second reason to be mentioned is the presence of an information asymmetry between the farmers and the administration (Latacz-Lohmann and Van der Hamsvoort, 1997). Only farmers actually know how participating in agri-environmental programs would affect their production and income. So they will calculate based on their individual costs and a price for the trades goods will emerge. This enables the possibility of a more efficient use of public funds as if the administration would fix flat-rate payments, without considering the farmers' costs of production.

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 relative new concept. Anyway 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). In Australia auctions are used in areas 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 (Stoneham et al., 2003). In Europe, a conservation scheme combining auctioning and fixed-price payments has been used in two counties in the state of North Rhine-Westphalia, Germany (Holm-Müller and Hilden, 2004). Moreover the Challenge Fund in the UK was based on auctioning to encourage additional afforestiation on private areas (CJC, 2004).

Even though very promising from a theoretical perspective and in some cases already approved in practice, there is still little evidence about the efficiency gains of auctions compared to payment schemes using fixed-prices. Furthermore reported results on cost-effectiveness gains vary greatly as for example 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. Contrary 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%. An

evaluation of the Central Scotland Forest and Grampian Challenge Fund for the Forestry Commission Scotland by CJC Consultants (2004) reports efficiency gains in the range of 33 to 36%.

Thus the paper sets out to investigate the first real-life implementation of auctioning plant biodiversity in Europe instead of simulations, laboratory experiments with students or a combination of auctioning with fixes payments. The study mainly aims at the discussion of the specific auction design used within the case study as well as its performance focusing farmers' acceptance, bid-prices and findings on efficiency gains through auctioning compared to existing state-run agri-environmental programs using fixed payments. Furthermore I stretch the farmers' perspective by evaluating the private transaction costs of taking part in both auctions.

The paper is structured as follows. The second section takes a look at general considerations on auction theory and the application of auctioning conservation contracts. Section three presents the case study background by introducing the specific auction design and its implementation. The results of both auctions are discussed in the fourth section including the submitted and accepted bids as well as comparative efficiency gains. Section five evaluates and discusses the farmers' transaction cost. Section six concludes and highlights further need for research.

2. Auctioning environmental services

2.1 Some auction theory and main considerations

In order to design an appropriate auction mechanism, I first take a look at general auction theory and its basic concepts. But as auction theory can be seen to be of „second-order importance for practical auction design" (Klemperer, 2002, p. 2), I introduce basic concepts and terms briefly and will soon turn to the auction design in the conservation contracts application. Auction theory basically distinguishes between the following four types of auctions, designed as selling auctions (Milgrom, 1989; Klemperer, 1999; 2002; Krishna, 2002; Chan et al., 2003; Jehiel and Moldovanu, 2003; Latacz-Lohmann and Schilizzi, 2005):

i. According to the rules of the *ascending-bid auction*, the price is raised by the auctioneer until only one bidder remains. This bidder wins the object at the final (highest) price. This kind of auction is also called open, oral, or English auction. In its most common form, it is not possible for one bidder to re-enter the auction after quitting it once.

ii. In the *descending-bit auction*, the auctioneer starts with a very high price, which is lowered continuously until one bidder states the willingness to accept the current price. The object is thus won at that price. It is also called Dutch auction because it is used in the sale of flowers in the Netherlands.

iii. In a *first-price sealed-bid auction*, each bidder submits a single bid independently without having information about the bids that other bidders make. The object is then sold to the bidder offering the highest bid price.

iv. The *second-price sealed-bid auction*[1] works in a similar way. The object is also sold to the bidder offering the highest bid price, but in contrast to the first-price sealed-bid auction, the price paid is the second-highest bidder's bid.

These standard selling auctions can also be adopted and used as procurement or reverse auctions, like in the case of auctioning ecological services. But as especially Latacz-Lohmann and Schilizzi (2005) point out, auctions for ecological services differ from basic auction design in many respects – as we will also see in the remainder of this paper. Thus auction theory is not well develop for this kind of specific auctioning and offers little guidance for designing such auctions in practice. Therefore I will now face some of the main characteristics of auctioning conservation contracts.

One aspect is the fact that conservation auctions are usually repeated auctions and bids for the same ecological service on one site are invited in a sequence of various bidding rounds instead of just a one-shot auction. This allows bidders to learn from the results of previous auctions and use this information to adjust their bids. Connected with bidders learning from prior auctions is the question of collusion. Collusion generally means that bidders may explicitly or tacitly agree to avoid a bidding-up of prices in an auction. In the case of the auctioning conservation contracts, they may collude to achieve the highest prices possible. A frequently repeated auction market is particularly vulnerable to this phenomenon because repeated interaction among the participants will expand the set of signalling and will allow the bidders to learn to cooperate. The important decision on the payment format will be discussed in the following section facing the farmers' bidding behaviour especially against the background of collusion.

[1] The second-price sealed bid auction is also called vickrey-auction; named after the Nobel-price winning economist William Vickrey (in 1996 and together with James Mirrlees).

Equally important is the attraction of a high number of participants in the auction to ensure sufficient competition among bidders. This can be a problem in any auction format, particularly, if the costs of entry and the asymmetries between bidders are too large (Klemperer, 2002).

Another aspect to be mentioned is the number of goods traded simultaneous and therefore to distinguish between single-unit auctions and multi-unit auctions. Auction theory mainly deals with the case of single-unit selling auctions, but conservation auctions are multi-unit procurement auctions and the administration selects various farmers with numerous heterogeneous sites to take part in the auction. Hence the administration needs to value the bids both using ecological as well as economic criterions and conservation auctions are characterised by an at least two-dimensional bid valuation.

Finally it needs top 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 therefore applicants are accepted until the budget is exhausted. Thereby exists no risk about the final costs the program will cause, but the amount of ecological services taken under contract it insecure. In contrast the target-constraint auction will be used if the number of contracts or in general the amount of ecological services is decided about and fixed a-priori; the budget finally needed to achieve this target is unknown. Another aspect of the auctioning scheme is the question of whether a reserve price should be set. A reserve price is a price “cap” that defines the maximum amount that the government agency is willing to accept (Stoneham et al., 2003).

To sum up at that point, information asymmetry is the key feature of auctions and particularly relevant for the functioning of markets for environmental goods and services. This is the case because these goods and services are often generated by lands that are private property. A farmer, in this case, usually knows his own land as the base of production opportunities better than any public agency. If a landowner considers participating in conservation program, he will thus know best how participation is likely to affect production opportunities and eventually farming income. On the other hand, the farmers may lack information about priorities in the agri-environmental policy or about the particular environmental significance of the ecosystem structures on their land.

Thus from a policy-makers point of view auctions to buy ecological services from landowners basically focus on budgetary cost-effectiveness and the possibility to gather information about the production costs of agricultural firms. Auctioning therefore represent a mechanism that is bound to ex-ante fixed rules with the agrarian administration on the demand side and various farmers on the supply side. Auctions can generally be defined as follows: "An auction is a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from market participants" (McAfee and McMillian, 1987, p. 701).

2.2 The payment format

To analyse bid values, standard auction theory has employed two basic models. 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 the same 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 learn other bidders' signals via bids. In contrast, the values in the private-value case would not change based on additional information on other bidders' preferences or bids (Klemperer 1999).

Landholders in practise are assumed to have independent private values. This seems to encourage a single round of bidding in connection with the expectation that bids will be based on individual opportunity costs. But in practice the administration usually needs repeated auctions and a common-value element may easily 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 official information is available to the bidders how the conservation agency values the sites with respect to their conservation value, the landholders will also have different assumptions on the relative value of their land. In order to avoid the appropriation of information rents and collusion, it has to be considered carefully what information will be given to landholders within the auction. Consequently and due to the fact that only *second-price sealed-bid auctions* are of interest in this case, there are two adequate payment formats as sealed-bid auctions to be used within repeated multi-unit auctions for ecological services in practise. These payment formats will now be briefly discussed in particular regarding the strategic incentives induced by it and the expected farmers' bidding behaviour (Latacz-Lohmann and Van der Hamsvoort, 1997; Cason and Gangadharan, 2003; Stoneham et al., 2003; Latacz-Lohmann and Schilizzi, 2005):

i. The *uniform-price sealed bid auction* where a sealed bid is submitted by each bidder, stating the individual price for a specific ecological service. The good is then bought at a price determined by the price of the highest winning bid or the lowest rejected bid and all successful bids are paid equal. Thus the individual bid price just determines the probability of acceptance but not the final payment and the theoretically optimal bidding strategy is revealing the accurate opportunity costs.

ii. The *discriminatory-price sealed bid auction* where also a sealed bid is submitted for every site, but all accepted bids are receiving payments according to the individual bid price. This creates incentives for bidders to bid a price above the individual opportunity costs and ensure themselves information rents if the bid finally is successful.

Hence the main difference between the uniform-price auction and the discriminatory-price auction lies in the fact that the bid price affects the height of the individual payment only within the discriminatory-price auction. On the basis of the above considerations the payment format of a uniform-price auction seems to be the best choice in theory, because it creates no incentives for overbidding the individual opportunity costs. But particularly facing the practical considerations of a case study implementation some further aspects need to be discussed.

A fundamental argument against uniform-price auctions is to be seen in the fact that farmers with low opportunity costs[2] would benefit disproportional from a higher payment, because the strike price reflects the required compensation for owners of more productive sites. So it is obvious that this uniform price could overcompensate farmers with least productive land and lead to an unacceptable overpayment and public criticism on the payment scheme (Latacz-Lohmann and Schilizzi, 2005). Besides questions of fairness and acceptance another aspect concerning uniform-price auctions needs to be taken into account. Within repeated uniform-price auctions bidders will be able to learn the uniform price paid to every successful bid and adjust their bids in the next auction. This kind of bidders' learning leads to bids no longer based on individual opportunity costs with negative effects on the efficiency of repeated auction performance.

[2] Owners of least productive or marginal land.

In contrast the critical incentive on overbidding the individual opportunity costs in discriminatory-price auctions could be reduced to some degree by using flexible reserve prices or budget-constraints within repeated auctions.

Finally the choice between both payment formats is obviously controversial in practise and neither auction theory nor former laboratory experiments and practical experiences are giving a clear guidance. Especially against the background of repeated auctions, the first time ever implementation of auctioning plant biodiversity in Europe and aiming at a great acceptance by farmers I tried to keep things as simple as possible within the case study. Therefore this specific auction design is based on a discriminatory-price auction and will be described in the following section.

3. Case study background

3.1 Auction design

Based on the above considerations I will now outline the specific auction design used within the German case study discussed in the remainder of this paper. The auction design is a repeated sealed-bid, discriminatory-price, multi-unit auction. Like common practice in agri-environmental programs this case-study also uses a budget-constraint auction, with a separate budget-constraint for each quality of ecological goods and no reserve price.

The aim is to reward landowners for their provision of environmental services, whereas the payment is – contrary to the majority of current agri-environmental programs in the EU – not based on actions undertaken by the farmers (Kleijn and Sutherland, 2003), but outcome orientated based on specify ecological services. These ecological services are defined as ecological goods of plant biodiversity (Bertke 2005). Ecological goods have to be clearly defined by transparent floristic criteria, so farmers are able to prove their fulfilment and a justifiable control of the supplied ecological goods can take place as a part of the payment scheme. In this case the production of the so called ecological goods “grassland” aims at the protection of regional endangered plant communities, the preservation of grassland on marginal sites and the promotion of species-rich grassland. Therefore the number of species per plot and a catalogue of grassland species that are adapted to extensive grassland management and characteristic for regional plant communities are suitable for the definition of ecological goods grassland. Related to the ecological quality the following three categories of ecological goods grassland were defined: grassland I, grassland II and grassland III,

whereas grassland III represents the highest quality of ecological services (Gerowitt et al., 2003; Bertke, 2005).[3]

Thus the case study uses a two-dimensional benefit criterion based on ecological and economic factors. From an economic point of view the bid price per hectare is taken into account. The ecological evaluation is based on the quality of the produced ecological services represented by the classification into grassland I, grassland II and grassland III. So within every category of ecological goods different prices are paid for the same quantity of a (heterogeneous) good.

The specific auction design therefore aims at budgetary cost-effectiveness as well as the possibility of generating information about the farmers' opportunity costs revealed via individual bid prices for every grassland site. The regional demarcation corresponds to a uniform exclusion border. To achieve a high number of participants and low possibilities for collusion, all kinds of farmers were allowed to take part with all their grassland sites located in the case study area (the county Northeim in the south of Lower Saxony).

3.2 Implementation and timetable

The case study altogether enfolded two auctions. Below the basic proceedings and the timetables of both auctions are described.

I. The first auction (2004/2005)

All conventional and ecological farmers with managed grassland sites in the model-region were qualified to submitted bids within the first auction, starting in the beginning of June 2004. In the meantime three information meetings were held to inform interested farmers about the basic procedure and the tender documents. The deadline for submitting quotations ended after six weeks and subsequent the bids were evaluated within one week. So the contracts were closed in the middle of July 2004. According to the outcome orientation, the ground control took place until the end of July 2005 and successful farmers were paid in August 2005.

[3] To sum up: the production of these ecological goods shall 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. Important is either the number of forbs per control plot (circle with 2m radius = 12.6m²) as well as the existence of regionally defined target species of extensive grasslands. The ecological goods and their represented ecological quality (amount of plant biodiversity) are defined as follows: grassland I: number of forbs >= 8/12.6m²; grassland II: number of forbs >= 8/12.6m² + 2 target species/12.6m²; grassland III: number of forbs >= 8/12.6m² + 4 target species.

II. The second auction (2006)

The fundamental auction design was kept the same within the second auction, but one change needed to be done due to a short-term safeguarding of the auction budget. This adaptation refers to the circle of eligible farmers and the auction was limited to those farmers already participated within the first auction. Therefore the tender documents were immediately sent to the relevant farmers in the middle of February 2006. The bids had to be received until the end of March 2006 and were again evaluated within a period of one week. The ground control took place by the end of July within the same year and after a successful control, the farmers got paid in August 2006.

4. Results – auction performance

4.1 Submitted bids

To participate in the auctions, landowners had to submit an individual bid for every grassland site, whereas one farmer was qualified to submit a various number of bids for all categories of ecological services. The offer includes the choice of the ecological good (grassland I, II or III), the calculation of the price per hectare and the exact description of the grassland site. The main results of the two first-price sealed-bid, discriminatory-price auctions within the case study area 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: own. Ø = mean; SD = standard deviation.

Analysing the wide ranges and standard deviations of the individual bid prices within every category of ecological goods and both auctions, it becomes clear that the farmers were in fact confronted with different opportunity cost represented by much differentiated bid prices for an in each case equal quality of ecological services. Within currently used fixed price payment scheme in the European agri-environmental policy these different costs for the provision of ecological services are unknown to the administration and therefore could not be considered for conservation contracting. In contrast auctioning implies strong incentives for farmers to share information about their opportunity costs, which could be used by the agri-environmental administration to reduce their information asymmetry and carry out an innovative, flexible and efficient conservation contracting.

Looking at the development from the first to the second auction the range of prices expanded only within the highest quality of ecological services – the ecological goods grassland III. For both ecological goods grassland II and grassland I the range of prices decreased on small scale and for the latter the influence of the strike price on bidders' learning becomes apparent. In the first auction all bids up to a price of €145 per hectare were accepted for the ecological goods grassland I. In the second auction especially the former rejected farmers learned and either reduced the bid prices or, if a reduction of the bid prices was not possible due to higher opportunity costs, did not supply the specific grassland site again in 2006. Thus the highest bid price in the second auction was adjusted to €160 per hectare. Furthermore the above findings on submitted bids show that even if the range of prices decreased for the ecological goods grassland I and (slightly) for the ecological goods grassland II it still has not come to any collusive price fixings having negative effects on the achievement of objectives intended by auctioning. The price level – as expected – raised within both auctions consisted with a higher quality of ecological services from good grassland I about good grassland II up to good grassland III.

Finally I will take a look on how the number of bids as well as the number of participating farmers developed from 2004/2005 to 2006. First of all it becomes clear that the number of sites (= the number of bids) especially arose for the relatively lowest quality of ecological services, but also within all other classes of ecological goods. It this case it needs to mentioned that in consequence of changing the auction design in 2006 the number of eligible farmers was limited to those farmers already participating in the first auction. So the increase of submitted bids from the first to the second auction in conjunction with an equal number of potential bidders can be interpreted as a growing interest, confidence and also acceptance of auctioning as a new instrument in the European agri-environmental policy.

4.2 Successful bids

Besides the above considerations on submitted bids I will now turn to answer the question, which bids could finally be accepted with the given budget-restrictions. Therefore the most important results of the successful bids are presented in table 2 for both auctions and all three categories of ecological goods.

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: own. Ø = mean; SD = standard deviation.

First of all we need to remember that both auctions are budget-constraint auctions with no reserve price and therefore the main influence on the number of accepted bids lies within the budget-restrictions for every ecological good. The total budget 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 the higher-quality goods depending on the number and size of sites. For the second auction a total budget of €26,000 was available and this time the budget was planed to be spent equal (about €8,667) on 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. So finally 159 sites by 28 farmers – covering an area of 288.56 hectares – were taken under contract. With the total bid sum of €51,481.23 the budget-restriction of €26,000 was also exceeded within the second auction and

therefore altogether 164 sites by 21 farmers could be accepted. This covers species-rich grassland in a total area of 238.46 hectare.

Looking at the price ranges and standard deviations of these accepted bids and their relevance for the final payment, the results clarify a still wide difference between individual bid prices and thus the consequences of discriminatory-price auctions for the final design of conservation contracting. Within both auctions and all classification of ecological services the budget was spent based on individual opportunity costs, revealed by the bid prices and the use of auctioning.

The additional analysis of accepted bid price levels in both auctions also shows an increase from the ecological goods grassland I, via the ecological goods grassland II up to the ecological goods grassland III. From the first to the second auction the price level decreased both for the ecological goods grassland I and grassland II mainly due to an adjustment by reducing the respective 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 development is caused by the adjustment of the subdividing of the total budget-restriction on the three categories of ecological goods in the repeated 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 ecological goods. To avoid this increase of accepted bid prices a reserve price of for example €350 could have been set in the second auction. But in this case study it was the aim to take as much highest-quality grassland sites under contract as possible and therefore this rise in prices needs to be accepted.

However these findings on accepted bids reveal both the flexibility and also the accountability for agri-environmental agencies within auctioning ecological services as well as its potential for a more efficient use of public means. If this case study auctions actually gained budgetary cost-effectiveness compared to fixed flat-rate payments will be discussed exemplarily in the following section

4.4 Does auctioning lead to efficiency gains?

Besides the sole analysis of bids and especially bid-prices per hectare I will now take a further look at practical efficiency gains by auctioning instead of using flat-rate payments in the case study area. Due to the specific auction design (outcome orientation, definition of the

ecological goods grassland I, II and III) it needs to be considered that currently no agri-environmental program exists, with an ecological goal that exactly fits with the auction. Therefore I will refer to the so called "Lower Saxony agri-environmental program, measure B: support of extensive grassland use".[4] 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 represented by eight different species.

By the time the case study took place, the farmers where paid within the agri-environmental program by a fixed payment of €103 per hectare. In the following I will compare the budget spend within both auctions with the necessitated budget if the same area would have been demanded using the flat-rate payment and thereby discuss the impact on practical efficiency gains by the use of auctioning.

In the first auction (2004/2005) an area of 198.25 hectares was taken under contract, whereas the relevant budget sums up to €16,100.84. To achieve the equivalent area by the using fixed payments of €103 a total budget of €20,419.75 would have been needed. So auctioning does in this case lead to savings of €4,318.91 or in other words efficiency gains of 21.2%.

The similar comparison for the second auction approves and even strengthens this positive evaluation. Using the fixed payment of €103, a budget of €13.395.15 must be paid to realise the ecological target of 130.05 hectare grassland taken under contract in 2006. In contrast this objective has been achieved by auctioning with a budget of only €8,527.30 which equals savings of €4,867.85 or 36.3%.

To sum up under consideration of all unavoidable empirical inaccuracy, these results clearly point out the specific real-life economic potential of auctioning and support the theoretically evident hypothesis of efficiency gains by the use of auctions compared to fixed flat-rate payments to reward farmers for producing ecological services.

5. Results – farmers' transaction costs

5.1 Basics and definition

Apart from the auction performance will now briefly examine the transaction costs – or in other words bureaucratic expenditure – participating in both auctions caused the farmers and therefore evaluate the case study auctions from a transaction cost economics point of view.

[4] In German it is called „Niedersächsische Agrarumweltprogramme, Maßnahme B: Förderung extensiver Grünlandnutzung".

In this case the transaction costs refer to the private transaction costs relevant for all farmers and therefore I will only consider the ex-ante-transaction costs. After submitting the bids there are no possibilities for additional adjustments and all further costs for the contribution of the defined ecological services are separated from the transaction costs as production costs and will not be analysed within this study. Therefore the transaction costs are defined as the expenditure of time for making an offer (acquisition of the tender documents, provision of information concerning the auction, selection as well as classification of the sites to be offered, calculation of the bid price and filling out the tender documents) monetary evaluated with an hourly wage.

To estimate the transaction costs I used three written questionnaires, with two of them referring to the first and one to the second auction. Within the questionnaires the farmers were – besides other questions not considered here – asked to note the relevant expenditure of time for participating in the auction. This expenditure of time represents the basis for the calculation of transaction costs and needs to be monetary evaluated in a second step. But which hourly wages should be consulted for this? Instead of using simplified external data I asked the farmers to also note the hourly wage estimated as appropriate and therefore include their individual valuation.

5.2 Relevance and proportion

In order to discus the relevance of the farmers' private transaction costs within the case study auctions the mean as well as the median sums per site (= per bid) of the submitted bids for all qualities of environmental services are presented in table 3 for both auction.

Table 3. Mean and median amount per submitted bid within both auctions

	1st auction (2004/2005)		2nd auction (2006)	
	Mean	**Median**	**Mean**	**Median**
Grassland I	€156.81	€116.47	€150.38	€98.70
Grassland II	€217.94	€182.53	€205.17	€152.86
Grassland III	€354.91	€142.88	€326.50	€318.00

Source: own.

Due to the fact that every landowner made a various number of bids I will not refer to the transaction costs per farmer, but to the mean and median transaction costs per site (= per bid) and evaluate their share of the mean and median sum per submitted site (= per submitted bid). The relevant transaction costs calculated as described above are as follows. The transaction costs per site based on the mean expenditure of time and the mean hourly wage are €14.26 in

the first auction and €6.84 in the second auction. The equivalent calculation based on the median expenditure of time as well as the median hourly wage results in transaction costs of €8.42 for the first auction and €5.53 for the second auction. Finally the mean and median farmers' transaction costs proportion of the bid sums for both auctions and all three ecological goods are shown in table 4.

Table 4. Farmers' transaction costs proportion of the bid sums

	1st auction (2004/2005)		2nd auction (2006)	
	Mean	**Median**	**Mean**	**Median**
Grassland I	9.1%	7.2%	4.5%	5.6%
Grassland II	6.5%	4.6%	3.3%	3.6%
Grassland III	4.0%	5.9%	2.1%	1.7%

Source: own.

Depending on the ecological good and whether the calculation it is based on the mean or the median, the results show a transaction costs proportion between 4.0 and 9.1% in the first auction. Within the repeated auction in 2006 the transaction costs decreased to a proportion in the range of 1.7 to 5.6%. These results clarify a relatively low amount of transaction costs for all ecological goods and also a decrease of their relevance from the first to the second auction, which illustrates clearly the transaction-cost-reducing effects of repeated (identical) auctions. These results support the positive evaluation of auctioning by pointing out that auctioning conservation contracts is practicable for the farmers and does not lead to disproportionately high bureaucratic expenditures, or in other word, transaction costs.

6. Conclusions

As agri-environmental agencies in Europe and around the world look for better ways of contracting landowners for the provisions of ecological services, some clear conclusions emerge from this case study. The results of both auctions point out that in fact much differentiated offers were made by the farmers in the model-region and that all main aims 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 without using an environmental benefits index, the results are sufficient to point out a substantial potential for cost reductions in comparison to more traditional measures in environmental and biodiversity conservation policy. As an indicator for a high and even growing acceptance of auctions from the farmers' perspective, the number of submitted sites arose from the auction 2004/2005 to

the second auction taking place in early 2006. Therefore and with regard to international economic aspects of biodiversity protection, this case study can be rated as a proof of how promising market-based approaches are and it is obvious that the empirical work indicates cost advantages of auctioning in comparison to fixed price schemes of up to 36%, depending on which scenario is chosen as a reference.

As already mentioned, the reported results on cost-effectiveness gains by auctioning compared to fixed flat-rate payments vary greatly as for example Stoneham et al. (2003) mention savings of up to seven hundred per cent for the first auction of the BushTender trial in Australia. Contrary a simulation of farmers bidding behaviour within a hypothetical payment scheme by Latacz-Lohmann and Van der Hamsvoort (1997) points out efficiency gains – depending on the auction design – in the range of 16 to 29%. An Evaluation for the Forestry Commission Scotland reports efficiency gains in the range of 33 to 36%. Therefore the results from the present case study suggest that specific savings from auctions are not nearly as high as reported by Stoneham et al., but fit very well with cost-effectiveness gains mentioned for the Central Scotland Forest and Grampian Challenge Fund (CJC Consultant 2004).

An additional analysis taking the private transaction costs into account shows that the proportion of the specific transaction costs in the bid sums of the submitted offers differs from 4.0 to 9.1% in the first auction and decreased to a range of 1.7 and 5.6% in the repeated auction. Thus these findings as well as a relative high number of farmers participating in the case study point out that auctioning conservation contracts is practicable, became popular with landowner and does not lead to disproportionately high bureaucratic expenditures respectively transaction costs. Furthermore the topic of biodiversity conservation turned from a primary complex and somewhat diffuse idea to practical actions and a source of farmers' income.

Even though the study presented in this paper has yielded more than promising results while a real life auctioning format was successfully implemented in a case study area, there are a number of long-run aspects yet to be considered and included in the planning of a conservation program based on auctioning.

Further need for research especially enfolds the dynamic and long-run development of the farmers' bidding behaviour and bid-prices during further auctions as well as the influences of different environmental services and regional demarcations on the practicability of auctioning. Thereby it needs to be analysed, in which circumstances auctioning is not feasible or will not lead to efficiency gains and a payment scheme only using fixed prices or a combination of

both instruments is the appropriate way within the European agri-environmental policy for the period 2007 to 2013 and beyond.

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