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A Meta-analysis of the Willingness To Pay for Cultural Services from Grasslands in Europe

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Abstract

We investigate the willingness to pay (WTP) for cultural ecosystem services from grasslands using a meta-analysis based on 32 eligible research papers that provide in total 79 estimates. The average WTP (corrected for purchasing power) across these studies is 38 Euros per person per year. Yet, our analysis reveals that the transfer of these results needs careful evaluation. More specifically, it is essential to frame the monetary valuation exercise in relation to the direction of grassland change. A switch from cropland to grassland reduces WTP by 90 Euros while an increase in less-intensive land-use in mountain regions raises WTP by 53 Euros. We conclude that for an adequate consideration of grasslands in holistic ecosystem services assessments, the direction of grassland change is important.

Keywords: *Willingness to pay (WTP); grasslands; cultural ecosystem services; meta-regression analysis.*

JEL classifications: *Q51, Q57.*

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1. Introduction

Grasslands are an important land-use type, covering about 40% of the earth's land surface (Blair *et al.*, 2014). In Europe, permanent grassland accounts for about one third of the agricultural area (Estel *et al.*, 2018). In mountainous regions, such as Switzerland, as much as two thirds of the agricultural area is grassland and forms the backbone of agricultural production (Mack and Huber, 2017). Grasslands also provide many ecosystem services (ES) such as fodder, carbon sequestration and biodiversity (Allan *et al.*, 2015). Moreover, cultural ecosystem services such as aesthetic, heritage or recreational values have also become important categories in the ES

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framework (Plieninger *et al.*, 2015). Valuation of grassland ES plays an important role in the management of multifunctional landscapes, e.g. in setting priorities for conservation efforts or agri-environmental measures through cost-benefit analysis (e.g. Albert *et al.*, 2017; Manning *et al.*, 2018; Randall, 2002;). This is especially relevant in the context of the European agricultural sector. For instance, the common agricultural policy focuses increasingly on environmental targets and uses agri-environmental measures to encourage farmers to protect and enhance grasslands and landscape features (Lefebvre *et al.*, 2015; Pe'er *et al.*, 2014). In Switzerland and Norway, farmers receive direct payments for grassland maintenance, in particular with regard to cultural landscapes in remote and mountain regions (e.g. Huber *et al.*, 2017; Kvakkestad *et al.*, 2015).

Marginality is one of the key concepts in the economic assessment of ES. The value of a particular ES is a function of (small) changes in land-use and associated ES provision flows (Fisher *et al.*, 2008). Thus, assessments of changes in welfare must evaluate marginal changes rather than estimate total values of overall ES. These marginal changes in ES provision in grasslands occur at both the extensive and intensive margins. Changes at the extensive margin imply either an increase or decrease in the total amount of grassland. Examples are conversion to/from cropland, forest regrowth or land abandonment. Changes at the intensive margin imply a change in grassland intensities, i.e. the number of cuts, use of fertiliser, grazing intensity, species composition and diversity (Finger and Buchmann, 2015).

We contribute to understanding the value of grassland ES and associated changes by conducting a meta-analysis of the willingness to pay for cultural ES from grasslands in Europe. This fills important gaps in the literature. Firstly, no systematic review exists on the valuation of cultural ES from grasslands. Secondly, many existing economic assessments of grassland ES fail to account for the nature of changes at the extensive and intensive margins, i.e. whether the change reduces cropland, increases forest or affects the intensity within grasslands. Existing valuation studies often treat grassland changes as a one-dimensional development and do not account for the direction of change (Albert *et al.*, 2017; Ciaian and Gomez y Paloma, 2011; Frélichová *et al.*, 2014; Schägner *et al.*, 2013; Schägner *et al.*, 2018; van Zanten *et al.*, 2014). Ignoring the direction of change may explain ambiguities in the findings of these studies. For example, some studies find that grasslands increase the value of landscapes, e.g. Ciaian and Gomez y Paloma (2011), while others find that they reduce the value of landscapes, e.g. Schägner *et al.* (2018).

We conduct a meta-regression analysis to synthesise existing empirical studies on the willingness to pay for cultural ES of European grasslands. We focus on European studies since the

valuation of ES is central to European agricultural and rural policies. Moreover, this restriction allows us to maintain a set of comparable agricultural and socio-economic systems in the meta-analysis. Our dependent variable is based on the willingness to pay estimates for grassland reported in the literature, comprising both contingent valuation methods and discrete choice experiments studies. The variation of willingness to pay for grasslands across and within these studies is explained using several controls for specific methodological and case study differences. Most importantly, we also report whether these studies assessed i) grassland abandonment, ii) a change to more extensive grassland use, or iii) implied a switch from cropland to grassland. The remainder of this paper is structured as follows. We begin by outlining the background of cultural ecosystem services and stated preference valuation. Then, we present our data collection and methodical approach. We present our results in the third section, followed by a discussion of our findings and conclusions.

2. Cultural Ecosystem Services and Stated Preference Valuation

In the existing literature, cultural ecosystem services are classified in seven categories: aesthetics, cultural heritage, spiritual and religious values, recreation, educational, inspirational and sense of place (MEA, 2005; Daniel *et al.*, 2012; Hernández-Morcillo *et al.*, 2013). Moreover, the existence value of biodiversity and habitat is also often categorised as a cultural service (e.g. Elmqvist *et al.*, 2010; Malinga *et al.*, 2015). In the reviewed literature for our meta-analysis, landscape aesthetics, cultural heritage, biodiversity conservation or recreational values have been used to frame the valuation exercise.

Most of the studies focus on aesthetics, i.e. the WTP for changes in landscape composition and use or cultural heritage. In multifunctional European landscapes, aesthetics play an important role. It is to be expected that more complex, coherent and natural landscapes are preferred over homogeneous or simple structures (Ode *et al.*, 2008). In this context, grasslands are important, not only as a constituting element of a heterogeneous landscape, but also as a transition between intensive croplands and forests (e.g. Hahn *et al.*, 2018; Schaich *et al.*, 2010). Many landscape preference studies show the positive effect of grasslands on the aesthetic value of landscapes (Hunziker *et al.*, 2008; Junge *et al.*, 2011; Lindemann-Matthies *et al.*, 2011; Schirpke *et al.*, 2016; Schüpbach *et al.*, 2008). In addition, the traditional use of grasslands, including extensive grazing, also represents an important element of cultural heritage, especially in mountain areas (Quétier *et al.*, 2010; Zoderer *et al.*, 2016). Various studies have exemplified the preferences for these traditional types of land-use (Cocca *et al.*, 2012; Marini *et al.*, 2011; Rewitzer *et al.*, 2017; Schenk *et al.*, 2007). Extensive grassland also contributes to biodiversity conservation

and habitat provision and its existence and bequest values (Bengtsson *et al.*, 2019). A few studies address biodiversity, especially in the context of agri-environmental programs or measures (e.g. Garrod and Willis, 1995; Hanley *et al.*, 1998; Meyerhoff *et al.*, 2012).

Grasslands may also be used for recreational activities such as hiking, nature observation, etc., (Schirpke *et al.*, 2018). While recreational activities often require built infrastructure, accessibility and other factors (Daniel *et al.*, 2012), the underlying ecological conditions and land-use types, including grasslands, are also of great importance (e.g. Fuller *et al.*, 2007; Harrison *et al.*, 2014; Junge *et al.*, 2009; Komossa *et al.*, 2018). Several studies show a link between aesthetics and recreation. For example, Rewitzer *et al.* (2017) show that people with more frequent outdoor recreation activities tend to have a higher WTP for landscape aesthetics. Other studies explain WTP for landscape aesthetics with preferences for recreation (Drake, 1992; Tempesta and Thiene, 2014; Sagebiel *et al.*, 2017; van Berkel and Verburg, 2014). In our meta-analysis, two studies explicitly address recreational values (Bullock and Kay, 1997; Marzetti *et al.*, 2011) and in two further studies, the authors assess aesthetics while controlling for recreational opportunities (Garrod and Willis, 1995; Hynes and Campbell, 2011; see Table 1).

Spiritual and religious values, education, inspiration and emotional perception of a place are other potential cultural ES from grassland. However, much less research has been devoted to these aspects than to aesthetics, cultural landscapes, biodiversity and recreation (Daniel *et al.*, 2012).

In our meta-analysis, consistency of the valued good or service is a key challenge. Subtle differences can be reconciled by including appropriate explanatory variables as regressors in the analysis (Rolfe *et al.*, 2015). Given the low numbers of studies in some of the cultural ecosystem service categories and the fuzzy boundaries between the different services in the reviewed literature, we here focus on two broad categories in the framing of cultural ecosystem services from grassland as control variables in our regression: i) the provision of landscape aesthetics including recreational values, and ii) cultural heritage and the existence value of biodiversity from low-intensity grassland use.

The monetary valuation of cultural ES is usually based on stated preference techniques, which ‘estimate measures of economic value using responses to survey questions’ (Johnston *et al.*, 2017). The collection of stated preference data can be broadly categorised into contingent valuation methods and discrete choice experiments. In contingent valuation studies, individuals are asked in surveys whether they prefer a proposed change in a public service or policy to

(usually) the status quo (Schläpfer, 2015). Respondents state a number expressing their valuation of the corresponding service using different elicitation formats (Carson and Louviere, 2011). In discrete choice experiments, respondents are asked to make a choice between two or more alternatives in a choice set. The alternatives presented for choice are constructed by means of an experimental design that varies one or more attributes (Carson and Louviere, 2011). Attributes describe the characteristics of the service being valued, e.g. the share of grassland in a landscape. Usually, the choices presented to the respondents involve randomly assigned prices in tax rates or per-unit charges drawn from an experimental design (Schläpfer, 2015).

Other techniques are available to value cultural ES, such as hedonic pricing (e.g. Brander and Koetse, 2011) or the travel cost method (e.g. Ezebilo, 2016), but they have not been applied to grasslands. Moreover, our focus on results from discrete choice experiments and contingent valuation studies ensures commensurability of the dependent variable, which is critical to meta-regression studies (Rolfe *et al.*, 2015). In this context, a recent systematic review on discrete choice experiments implies that the results are usually similar to contingent valuation methods (Rakotonarivo *et al.*, 2016) and elicitation formats do not affect the estimation of attribute values in ecosystem-service valuation (Petrolia *et al.*, 2018). Thus, we combine willingness to pay estimates from contingent valuation methods and discrete choice experiments and control for methodological characteristics in the meta-regression analysis.

There is an ongoing debate regarding the usefulness and reliability of stated preferences in ES valuation (Gómez-Baggethun and Ruiz-Pérez, 2011; Schröter *et al.*, 2014; Rakotonarivo *et al.*, 2016). A meta-analysis does not overcome any of the potential drawbacks or methodological weaknesses of the primary studies. However, we believe that a meta-analysis offers a valuable synthesis and provides important insights into the variability of the willingness to pay for cultural ecosystem services from grasslands. Moreover, it allows structural differences in valuation studies to be tested (Bergstrom and Taylor, 2006; Rolfe *et al.*, 2015).

3. Method

We structured our methodological approach along the guidelines on economic meta-analysis as presented by Stanley *et al.* (2013).²

Our research question is whether and how the direction of change in grasslands, i.e. reduction in cropland, increase in forest or change in intensity levels influences the economic valuation of cultural ES from grasslands. We used the willingness to pay for grasslands to measure the economic value of cultural ES. An appropriate and consistent set of primary studies is established by focusing on studies that quantified willingness to pay per person or per household and year for grasslands in Europe using either contingent valuation methods or discrete choice experiments. The reported estimates were converted into Euros per person per year using the exchange rate of the year of the study. In addition, we adjusted estimates from different countries and years to account for purchasing power parities (Eurostat, 2019). Signs were switched in studies that value a reduction in grasslands. Thus, if surveys showed a positive willingness to pay for a change from grassland to cropland, this implies that people would have to be compensated with the same amount for a change from cropland to grassland.

The methods used in the studies collected to assess the willingness to pay for grassland do not allow further standardisation of the effect size, e.g. the willingness to pay per person or household *per ha* of grassland. In particular, most of the studies we reviewed assessed willingness to pay using pictures of landscapes or asked for a choice in a case study region without documentation of the effective spatial extent of the corresponding change. Thus, our analysis does not provide a *direct* basis for benefit transfer. However, it investigates the effect of the type of change. It controls for the cultural ecosystem service, methodological and case study specific variables and thus offers suggestions for improvements in the design of cultural ES grassland studies and opens new perspectives for the transfer of grassland benefits (Nelson and Kennedy, 2009).

3.1. Data collection

Our search for appropriate primary studies reporting on willingness to pay estimates for cultural ecosystem services for grasslands in Europe involved three steps. First, we checked the references cited in existing reviews about landscape valuations in Europe (i.e. Ciaian and Gomez y Paloma, 2011; van Zanten *et al.*, 2014) and in mountain regions (Grêt-Regamey *et al.*, 2008) to

² We also included a description of our meta-analysis based on the PRISMA-P checklist by Moher *et al.* (2015) in online Appendix D.

see whether they included grassland as an explicit feature or element in the valuation exercise. We found 19 studies that corresponded to our search criteria, i.e. referring to grasslands, Europe and stated preference techniques. Second, we explored the Environmental Valuation Reference Inventory database for contingent valuation studies that included grassland (EVRI 2018). There were 13 studies, 6 of which had not been reported in the existing reviews. Third, we looked through databases including Scopus, Web of Science and Google Scholar for studies that included grassland AND economic valuation. In this third step, we were able to locate eight additional studies. In total, we identified 33 publications (Table 1) that corresponded to our search criteria, with 88 reported willingness to pay estimates. Study 5 (Table 1) presented the same estimates from an earlier manuscript considered in our review and was excluded from our dataset. We also excluded six observations in which the willingness to pay was presented in relation to the area and not with respect to persons or households (from Studies 16, 21 and 31). In addition, we had to exclude one observation because the study reported predicted values rather than the original estimates. We restricted our investigation to i) peer reviewed publications, ii) conference proceedings, and iii) PhD theses in English, German and French. Our final dataset thus included 32 studies and 79 observations (see Appendix A, online, for a full presentation of the data and sources). Note that we were not able to collect the standard errors for all the estimates from the original studies, but could retrieve sample sizes for all studies.

Table 1: List of reviewed willingness to pay studies valuing grassland

	Author(s) and year of publication	Title	Journal
1	Willis and Garrod (1992)	Assessing the value of future landscapes	Landscape and Urban Planning
2	Drake (1992)	The non-market value of the Swedish agricultural landscape	European review of agricultural economics
3	Garrod and Willis (1995)	Valuing the benefits of the south downs environmentally sensitive area	Journal of Agricultural Economics
4	Bullock and Kay (1997)	Preservation and Change in the Upland Landscape: The Public Benefits of Grazing Management	Journal of Environmental Planning and Management
5	Hanley, MacMillan et al., (1998)	Contingent Valuation Versus Choice Experiments: Estimating the Benefits of Environmentally Sensitive Areas in Scotland	Journal of Agricultural Economics
6	Křůmalová (2002)	Evaluation of chosen benefits on environment and landscape coming from Czech agriculture	Agricultural Economics (CZ)
7	Schmitz, Schmitz et al., (2003)	Valuation of landscape functions using choice experiments	Agrarwirtschaft
8	Schmitt, Schlöpfer et al., (2005)	Bewertung von Landschaftsveränderungen im Schweizer Mittelland aus Sicht der Bevölkerung	Report
9	Baumgart (2005)	Bewertung landschaftsrelevanter Projekte im Schweizer Alpenraum - Die Methode der Diskrete-Choice-Experimente	PhD Thesis
10	Schmitz (2006)	Die Bewertung von Multifunktionalität der Landschaft mit diskreten Choice Experimenten	PhD Thesis
11	Campbell (2007)	Willingness to Pay for Rural Landscape Improvements: Combining Mixed Logit and Random-Effects Models	Journal of Agricultural Economics
12	Moran, McVittie et al., (2007)	Quantifying public preferences for agri-environmental policy in Scotland: A comparison of methods	Ecological Economics
13	Schlöpfer and Schmitt (2007)	Anchors, endorsements, and preferences: A field experiment	Resource and Energy Economics
14	Campbell, Hutchinson et al., (2009)	Using choice experiments to explore the spatial distribution of willingness to pay for rural landscape improvements	Environment and Planning A
15	Borresch, Maas et al., (2009)	Modelling the value of a multifunctional landscape - A discrete choice experiment	Presentation at International Association of Agricultural Economists Conference
16	Hasund, Kataria et al., (2011)	Valuing public goods of the agricultural landscape: a choice experiment using reference points to capture observable heterogeneity	Journal of Environmental Planning and Management
17	Howley, Hynes et al., (2010)	The citizen versus consumer distinction: An exploration of individuals preferences in Contingent Valuation studies	Ecological Economics
18	Yadav, van Rensburg et al., (2010)	Comparing the conventional Stated Preference Valuation Technique with a Prediction Approach	The 84th Annual Conference of the Agricultural Economics Society

19	Hynes and Campbell (2011)	Estimating the welfare impacts of agricultural landscape change in Ireland: a choice experiment approach	Journal of Environmental Planning and Management
20	Hynes, Campbell et al., (2011)	A Holistic vs. an Attribute-based Approach to Agri-Environmental Policy Valuation: Do Welfare Estimates Differ?	Journal of Agricultural Economics
21	Huber, Hunziker et al., (2011)	Valuation of agricultural land-use scenarios with choice experiments: a political market share approach	Journal of Environmental Planning and Management
22	Marzetti, Disegna et al., (2011)	Conservation and recreational values from semi-natural grasslands for visitors to two Italian parks	Journal of Environmental Planning and Management
23	Meyerhoff, Angeli et al., (2012)	Valuing the benefits of implementing a national strategy on biological diversity - The case of Germany	Environmental Science & Policy
24	van Berkel and Verburg (2014)	Spatial qualification and valuation of cultural ecosystem services in an agricultural landscape	Ecological Indicators
25	Christie and Rayment (2012)	An economic assessment of the ecosystem service benefits derived from the SSSI biodiversity conservation policy in England and Wales	Ecosystem Services
26	Bernués, Rodríguez-Ortega et al., (2014)	Socio-Cultural and Economic Valuation of Ecosystem Services Provided by Mediterranean Mountain Agroecosystems	PLoS ONE
27	Wüstemann, Meyerhoff et al., (2014)	Financial costs and benefits of a program of measures to implement a National Strategy on Biological Diversity in Germany	Land Use Policy
28	Dallimer, Jacobsen et al., (2015)	Patriotic Values for Public Goods: Transnational Trade-Offs for Biodiversity and Ecosystem Services?	BioScience
29	Tempesta and Thiene (2014)	The willingness to pay for the conservation of mountain landscape in Cortina D'Ampezzo (Italy)	Working paper
30	Tinch, Colombo et al., (2015)	The Impacts of Elicitation Context on Stated Preferences for Agricultural Landscapes	Journal of Agricultural Economics
31	Rewitzer, Huber et al., (2017)	Economic valuation of cultural ecosystem service changes to a landscape in the Swiss Alps	Ecosystem Services
32	Sagebiel, Glenk et al., (2017)	Spatially explicit demand for afforestation	Forest Policy and Economics
33	Mazzocchi and Sali (2018)	Assessing the value of pastoral farming in the Alps using choice experiments: evidence for public policies and management	Journal of Environmental Planning and Management

Note: Full details to the papers are given in the reference list of this article.

3.2. Data description

The independent variables were coded in three categories i) direction of grassland change and cultural ES framing, ii) methodological design, and iii) case study characteristics (Table 2).

First, categorical variables were used to categorise reported willingness to pay estimates per person or per household per year according to whether they addressed i) grassland abandonment, ii) less-intensive grassland use, or iii) a switch from cropland to grassland. A dummy variable was used for each of the three categories to assign the assessed grassland ES with respect to their framing, i.e. whether the valuation exercise of the cultural ES referred to landscape aspects (aesthetics) and recreational values, or to cultural heritage and biodiversity conservation.

Second, we collected the methodological characteristics of the studies. The studies were coded according to type to allow us to control for a systematic difference between contingent valuation methods and discrete choice experiments. In addition, we controlled for different elicitation formats, i.e. the way the grassland change was presented and the willingness to pay question was asked. To this end, we checked whether the study used a so-called ‘matching strategy’, i.e. open-ended questions and payment card formats or a discrete choice setting (Carson and Louviere, 2011). If the question was based on an open-ended or payment card format, we also recorded whether the authors framed the question showing two alternatives, i.e. in a dichotomous choice or referendum format. Furthermore, we coded the studies according to whether a single or a sequence of questions was asked.

We also assessed the presentation of the changes in cultural ES and registered whether the changes were presented in pictures or only by means of a descriptive text. Moreover, we noted whether the proposed change in a public service was presented in marginal units, i.e. in a small number of hectares or species, or in absolute changes, i.e. in changes on manipulated photos or pictures of the entire landscape. Different elicitation formats were used to test the sensitivity of our results with respect to sub-groups of our data sample.

Third, we used case study specific variables. We controlled for factors in the execution of the survey, i.e. whether data were collected via mail survey or in face-to-face interviews and whether the study was based on a probability or non-probability sampling. In addition, we included the year of the study and number of participants and also coded who precisely was surveyed, i.e. local residents, visitors and tourists, or the general public. We used the gross domestic product (GDP) and the expenditure per capita in purchasing power standards (PPS) taken from the eurostat database (Eurostat, 2019) to account for differences in wealth and standard of

living. In addition, the studies were classified with respect to their institutional state, i.e. if the region comprised a natural park or an environmentally sensitive area.

Various spatial aspects of the studies were likewise examined. We coded whether a study was performed on a national scale or within a specific case study region. In the latter case, we recorded the size of the region involved. Since many of the studies were performed in the UK and Ireland, we controlled for potential regional biases. We also checked the policy framing of the valuation exercise, i.e. if it directly included an agri-environmental scheme or not. Finally, we identified the landscape type in the valuation exercise, i.e. whether the study focused specifically on mountain (or upland) regions.

Our data were collected and coded by three researchers who discussed differences in the independent assessments and jointly agreed on the final dataset.

Table 2: List of variables encoded from the literature review

	Variable	Description	Coding		Mean	Standard deviation
		Depended variable				
	WTP	Expressed WTP in Euro (using the exchange rate in the year of the study and corrected for purchasing power parity)	Euro per person or household per year		38.46	53.43
		Independent variables				
Framing CES	TypChange I	Direction of change: from intensive to less intensive grassland use	Abandonment & cropland (0)	Less-intensive (1)		
			37	42		
	TypChange II	Direction of change: from cropland to grassland	Abandonment & less intensive (0)	Cropland to grassland (1)		
			69	10		
	TypES	Framing of the ES subject to valuation	Landscape aesthetics (0)	Cultural heritage / biodiversity (1)		
			48	31		
Methodological design	Method	Underlying method	CVM (0)	DCE (1)		
			32	47		
	Marginal	Representation of change in countable, small units (e.g. number of species) or rather absolute changes (e.g., change in grassland on pictures)	Marginal changes (0)	Absolute change (1)		
			29	50		
	Open ended	Open ended format of WTP question	No (0)	Yes (1)		
			62	17		
	Payment card	Use of payment card as a payment vehicle in WTP question	No (0)	Yes (1)		
			64	15		
	Dichotomous	Choice between two landscapes before either open ended question or payment card format	No (0)	Yes (1)		
			64	13		
	Sequential	Single or a sequence of questions	No (0)	Yes (1)		
			25	54		
	MNC	Multinomial choice setting	No (0)	Yes (1)		
			32	47		
	Text	Illustration of WTP with pictures, symbols or only with text	Text (0)	Symbols or pictures (1)		
			12	67		
			12	67		

Case study related	Year	Year in which the study took place (if not reported, year of publication)	Yearly time steps 1986 = 1; 2015 =28			
	Person	WTP on individual or on household level	Individual (0)	Household (1)		
			42	37		
	Int	Collection of results using face-to-face interviews or any other type of survey e.g., per mail or online	Survey (0)	Interview (1)		
			33	46		
	Sampling	Whether the data was based on a probability or non-probability sampling	Non-probability sampling (0)	Probability sampling (1)		
			12	67		
	Participants	Number of participants who expressed their WTP	Number		456	395
	Visitor	Characterization of the participants with respect to their origin: Visitors	Local residents & general public (0)	Visitors or tourists (1)		
			68	11		
	Public	Characterization of the participants with respect to their origin: General public	Local residents & visitors (0)	General public (1)		
			17	62		
	Program	Consideration of a specific policy program	No (0)	Yes (1)		
			59	20		
	Region	Did the study specifically address a mountain region or not (including upland regions in the UK)?	No (0)	Yes (1)		
			47	32		
	Park	Did the survey / interviews take place in a park or an area in the habitat directive?	Yes (0)	No (1)		
			40	39		
	Country	Study in the UK or Ireland?	Yes (0)	No (1)		
			28	51		
	Nation	Case study or national level?	Case study (0)	National (1)		
			53	26		
	Size	Size of the case study area (if not on a national level)	Km ²		919	778
	GDP	GDP in the year of the study	Euro		33'228	11'673
	Living standard	Real expenditure per capita in PPS (EU 28 in 2010 =100)	%		119.8	23.78

3.3. Econometric analysis

We use regression analysis to explain the variation in reported willingness to pay estimates. More specifically, we aimed to identify the effects of the type of grassland change and cultural ES, methodological variables and case study related variables. We estimated several specifications of the following regression model:

$$WTP_i = \beta_0 + \beta_k X_{ki} + \epsilon_i$$

where WTP_i with $i = 1 \dots 79$ represents the identified willingness to pay estimates from our data collection, X_k is a vector containing k variables related to the framing, study design and case study specifics used to estimate the willingness to pay (WTP) for grassland, and ϵ_i is an error term. We used the MM-estimator. This is a robust regression technique that allows the potential impacts of outliers to be reduced while maintaining high efficiency of the estimator (Finger, 2010). Moreover, we applied multi-way clustering based on Cameron *et al.* (2011) to adjust standard errors for variations within clusters, i.e. to account for possible multiple estimates reported by the same research article. This accommodates within-study dependence.

Collinearity problems were identified by analysing correlations between variables. The variance inflation factors of the selected model were estimated to test for any remaining potential problems of multicollinearity (Fox and Monette, 1992). Variables with potential multicollinearity problems were dropped (see Appendix B, online, for a full explanation of variable choice and estimation strategy). Finally, a subsample sensitivity analysis was performed to ascertain whether our regression is affected by the exclusion of the estimates for a switch from cropland to grassland (see Appendix B, online, for a full presentation of regression diagnostics and sensitivity analysis).

Publication selection bias in meta-analysis refers to the fact that statistically significant results are essentially more likely to be published than those without any statistical significance (Hirsch, 2018; Stanley, 2005). Since standard errors are not available for all the studies included in our analysis, we used the sample size to measure the precision of estimates (Sterne *et al.*, 2000 and Macaskill *et al.*, 2001). To be specific, we tested for publication selection bias by regressing reported values to the square root of the sample size in the corresponding study (funnel asymmetry test). We found that the sample size had no effect on the willingness to pay. This implies that observed effects vary randomly around the ‘true’ effect, i.e. the mean of the 10% of the studies with the highest square root of the sample size and that there is no publication bias in our study selection (see analysis in Appendix B, online). Thus, we assign each study

equal weight in our meta-regression. The analysis was conducted using R (code available in Appendix C, online).

4. Results

4.1. Willingness to pay for grassland

Figure 1 shows estimates for grassland ecosystem services published over the period 1990–2018, by date of publication. The average willingness to pay indicated by these estimates is 38 Euros (Median 32 Euros) with a range from –112 to +236 Euros. The smallest positive willingness to pay (0.8 Euros for grassland in Czech Republic) is almost 300 times smaller than the highest estimate (236 Euros for grassland in Swiss mountains). This kind of variation across studies is typical for valuation studies and an important motivation for meta-analysis (Rolfe *et al.*, 2015). In addition, we see that the number of choice experiment studies increased compared to contingent valuation methods studies over our data period (see also Mahieu *et al.*, 2017). The descriptive analysis also showed that willingness to pay for grassland ES was higher for a reduction in grassland intensity levels in a mountain region and lower for a switch from cropland to grassland in other regions (Figure 2). These differences in the willingness to pay for the different types of grassland changes is also present in all the sub-samples analysed (Appendix Figure B4, online).

Figure 1. Willingness to pay (WTP) for cultural ecosystem services (CES) from grasslands in studies using a contingent valuation method (black) or a discrete choice experiment (grey) published over the period 1990 – 2018. Note: The study by Drake was conducted in 1986 and published in 1992.

Figure 2. Box plots of reported willingness to pay estimates in Euro per person or household per year for abandonment (grey), less-intensive grassland use (light grey) and cropland (white) across mountain and lowland regions. Box plots summarize the 79 observations collected in our review. The black line represents mean WTP. Boxes include the second and third quantile of willingness to pay estimates. The whiskers show the 10th–90th percentiles. Outliers above and below the whiskers are drawn as individual points.

4.2. Estimation results

Table 3 shows the estimation results for the main model and three subsets of the data. The willingness to pay per person and year varies significantly between changes from cropland to grassland as compared to abandonment or less-intensive grassland use when the full dataset (Model 1) is applied. In addition, interaction effects between regions and the type of change are also significant. More specifically, if a switch from cropland to grassland is evaluated in mountain regions, the willingness to pay is higher compared to such changes in the lowlands. In mountain regions, a change to less-intensive grassland use also generates higher willingness to pay. These variables remain significant in all the specifications of the econometric estimation. Thus, our results provide a robust indication that the direction of change clearly influences the willingness to pay for grassland (*cf.* sensitivity analysis in Appendix B, online). In addition, the willingness to pay also increases by approximately 20 Euros if the grassland cultural ES is framed in the context of cultural heritage rather than landscape *per se*.

Table 3: Meta-regression of willingness to pay for cultural services in European grassland

Dependent variable: WTP corrected for purchasing power parity per country and year (in Euro)	Model 1: Full dataset, accounting for abandonment – less intensive – cropland			Model 2: Sensitivity analysis using only those observations that address abandonment and less-intensive grassland use			Model 3: Sensitivity analysis including the size of the study region as explanatory variable and excluding studies on national level.			Model 4: Sensitivity analysis without observations based on direct open ended questions		
	Estimate	Pr(> t) [§]		Estimate	Pr(> t) [§]		Estimate	Pr(> t) [§]		Estimate	Pr(> t) [§]	
Intercept	-21.13	0.405		-7.06	0.765		-17.07	0.657		-1.51	0.958	
Abandonment – Less intensive	-14.61	0.059	.	-13.45	0.049	*	-5.71	0.684		-19.75	0.067	.
Region	-46.04	0.000	***	-49.14	0.000	***	-50.57	0.004	**	-54.24	0.004	**
Abandonment – Cropland	-116.61	0.000	***				-111.20	0.000	***	-125.02	0.000	***
Framing of CES	13.70	0.083	.	17.96	0.038	*	15.67	0.003	**	13.84	0.098	.
Marginal	42.41	0.000	***	46.03	0.000	***	47.17	0.000	***	37.59	0.001	***
Dichotomous choice setting	48.89	0.000	***	47.59	0.000	***	44.22	0.017	*	56.97	0.000	***
Open ended	-4.35	0.662		-9.81	0.332		-18.94	0.019	*	-0.94	0.964	
Person / household	-2.45	0.645		0.47	0.929		-4.39	0.640		-0.04	0.994	
Multinomial choice setting	36.98	0.021	*	29.42	0.061	.	31.73	0.012	*	34.38	0.031	*
Interview / survey	-10.20	0.095	.	-11.62	0.061	.	-3.81	0.760		-15.42	0.099	.
Text / picture	-19.11	0.007	**	-20.69	0.001	**	-27.93	0.080	.	-18.64	0.036	*
Year	1.35	0.005	**	1.47	0.000	***	1.42	0.007	**	1.78	0.022	*
Number of participants	-0.03	0.006	**	-0.03	0.003	**	-0.03	0.122		-0.04	0.002	**
Local – visitors, tourists	-15.75	0.024	*	-16.52	0.040	*	-12.00	0.149		-25.39	0.163	
Local – general public	-4.40	0.580		-8.50	0.302		-7.95	0.550		-16.94	0.200	
Agri-environmental program	27.43	0.200		15.21	0.471					34.07	0.034	*
Park	7.08	0.283		8.33	0.187		10.97	0.103		1.35	0.870	
Expenditure	0.21	0.103		0.14	0.254		0.20	0.063	.	0.22	0.082	.
Size							0.01	0.193				
Less intensive : Mountain	48.28	0.011	*	55.03	0.001	***	58.55	0.006	**	47.66127	0.052665	.
Cropland : Mountain	110.05	0.000	***				137.60	0.000	***			
R ² (adj.)	0.79			0.72			0.79			0.79		

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1; [§]Error terms clustered by study.

A sensitivity analysis using only those observations that address abandonment and less-intensive grassland use ($n=69$) shows that the same variables remain significant (Table 3, Model 2). Willingness to pay for less-intensive grassland use in mountain regions is still significantly higher compared to abandonment and less-intensive grassland use in the lowlands. We also controlled for the size of the case study region in an additional subsample. Again, the estimates with respect to type of change, region and cultural ES framing did not differ significantly (Table 3, Model 3). In each case, the direction of change and the type of cultural ES have a significant impact on the willingness to pay for grasslands. Finally, this result is also confirmed even when observations with an open-ended question (Table 3, Model 4) are not considered.

Our results also demonstrate the relevance of methodological and study related variables when explaining the variation in peoples' willingness to pay for grassland ES. In particular, willingness to pay increases when the changes are presented as absolute rather than marginal changes. Moreover, studies that required participants to respond to a dichotomous choice or a referendum format led to higher estimates. In the sub-dataset without changes from crop to grassland (Model 2), willingness to pay declined when surveys were carried out instead of interviews and pictures were presented instead of texts only. Multinomial choice settings generally resulted in higher estimates. Other methodological variables did not affect willingness to pay in our analysis. We re-ran the econometric analysis considering contingent valuation methods and discrete choice experiments studies separately as a robustness check. The results reveal that the direction of grassland change, i.e. grassland abandonment, reduction in cropland or change in intensity levels was always a significant variable despite the lower observations in the split sample. However, the framing of cultural ES and the region, i.e. mountain or not, was not significant in contingent valuation methods.

The year of the survey was a significant variable in relation to the study. However, it was strongly correlated with GDP (see Appendix Table B1, online, for correlation analysis and calculation of variance inflation factors). We excluded GDP from the regression as it was also correlated with expenditure. Thus, the annual increase in willingness to pay can, to some extent, be explained by the increase of GDP in all countries during the period analysed. In general, visitors exhibited a lower willingness to pay than the local population and residents. However, this effect is not significant in all the subsamples. Estimates increased when framed in the context of an agri-environmental measure if those studies using an open-ended question were excluded. Finally, the size of the case study region also increases willingness to pay in our subsample. Other independent variables related to the case study were not significant in our meta-regression.

5. Discussion and Conclusion

Grasslands provide a wide range of ES with various benefits for society. We provide a meta-analysis on the monetary valuation of cultural ES of grasslands in Europe using data from 32 studies that provide a total of 79 estimates on the willingness to pay. Our results show a positive and significant willingness to pay for cultural ecosystem services of grasslands. However, we find that the monetary valuation exercise must be framed in relation to the direction of grassland change. A switch from cropland to grassland reduces willingness to pay by 90 Euros, while an increase in less-intensive land-use in mountain regions raises willingness to pay by 53 Euros. We find that willingness to pay also increases by approximately 20 Euros if the grassland cultural ES is framed in the context of cultural heritage or biodiversity rather than landscape aesthetics or recreational values. Our results open the way to an improved perception of grasslands in cost-benefit analysis and, ultimately, support the design and evaluation of conservation or agri-environmental measures (Pascual *et al.*, 2010; Richardson *et al.*, 2015).

In addition, our meta-analysis shows the importance of methodological related choices in stated preference studies. The results imply that surveys including dichotomous or multinomial choices increase peoples' willingness to pay for cultural ecosystem services from grasslands. This finding is in line with similar meta-analysis of landscape values (Ciaian and Gomez y Paloma, 2011), recreational values (e.g. De Salvo and Signorello, 2015; Schägner *et al.*, 2018), biodiversity conservation (Jacobsen *et al.*, 2009) or values of threatened species (e.g. Richardson and Loomis, 2009; Subroy *et al.*, 2019). In addition, willingness to pay is higher when the survey participants valued a change in the landscape compared to a change in number of species or a defined percentage change in land-use. This result may indicate that there is a part-whole bias in our set of studies implying that respondents valued a more inclusive category rather than the individual good or attribute framed in the study (Hanley *et al.*, 1998). Other methodological variables such as surveys instead of interviews and text instead of pictures lead to a lower willingness to pay. Other meta-analyses controlling for these variables show mixed results. While some studies also show a reduction in the willingness to pay in surveys compared to interviews (Rolfe *et al.*, 2015), there is little evidence that the mode of questionnaire in general affects willingness to pay estimates (e.g., Lindhjem and Navrud, 2011). Subroy *et al.* (2019) in their meta-analysis found no effect of pictures on the willingness to pay for endangered species. In this context, recent research shows that visualisation might reduce choice consistency and require more time to complete the choice tasks (Eppink *et al.*, 2019). These control variables,

however, should be interpreted with care due to the restricted number of studies and the categorical nature of our classification (see also Figure B2 in the Appendix, online).

Although the use of meta-analytic based value transfers is an efficient way to obtain values of local ecosystem services (Bergstrom and Taylor, 2006; Pascual *et al.*, 2010; Richardson *et al.*, 2015; Rolfe *et al.*, 2015), our analysis does not identify benefit transfer relationships, since we lack the necessary spatial dimensions for both the values and the explanatory variables. However, our meta-analysis does provide important information for holistic analysis of cultural ES and the development of benefit transfer functions in mapping and modelling studies (e.g. Burkhard *et al.*, 2013; Plieninger *et al.*, 2013; van Berkel and Verburg, 2014).

Our findings have two direct implications for future studies addressing the valuation of grasslands, e.g. in cost-benefit analysis of conservation and agri-environmental measures. First, our results show that the switch from cropland to grassland does not automatically lead to an increase in the landscape value as implied by Ciaian and Gomez y Paloma (2011). In this context, recent literature also shows that the initial land-use and land cover configuration have important impacts on peoples' willingness to pay (Sagebiel *et al.*, 2017) and that grassland conservation may be most effective in simple, i.e. non-complex and non-heterogeneous landscapes (Tschamntke *et al.*, 2012). We were unable to consider the initial configuration of land-uses in the different studies. However, the high variability of willingness to pay with respect to switches from cropland to grassland implies that further research should address the direction of change in economic assessments of grassland cultural ES and thus the initial land-use and land cover composition (see also van Zanten *et al.*, 2014).

Second, our findings suggest that peoples' willingness to pay is higher for less-intensive grassland use in mountain regions compared to both the prevention of land abandonment and less-intensive grassland use in the lowlands. Our results thus imply that the prevention of land abandonment would provide additional value if the corresponding grassland management strategy included traditional management activities and/or the preservation of biodiversity and cultural heritage aspects of grassland ES. Current trends in the European Alps, however, show a decline in traditional land-use and grassland management (Brunner *et al.*, 2017; Marini *et al.*, 2011; Schirpke *et al.*, 2017). Up until now, literature has neglected this aspect and it really must be considered in future attempts to estimate and transfer the monetary value of grasslands. In addition, it should also be an important factor in other (more holistic) methodological approaches addressing the valuation of grasslands.

In the context of policy design, efficient support for permanent grassland depends essentially on the targeting of corresponding policy measures to achieve a specific goal (van Tongeren, 2008). Permanent grassland is often seen as an important measure to provide multiple ecosystem services jointly (Manning *et al.*, 2018). In this respect, our findings underline the spatial component of targeted support for grassland ecosystem services (Engel, 2016). Support of permanent grasslands *per se* does not automatically promote the provision of those cultural ES that are valued by the public, especially in crop dominated agricultural landscapes. Moreover, the support of less intensive grassland in mountain regions could generate synergies between the prevention of land abandonment and the provision of cultural heritage values and biodiversity conservation. Policies addressing land abandonment in these mountain regions could reinforce the value of cultural ES by including cultural heritage aspects in their design.

Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Appendix A: Data

Appendix B: Sensitivity analysis and robustness checks

Appendix C: R code

Appendix D: PRISMA checklist

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