FARMERS' PERCEIVED COST OF LAND USE RESTRICTIONS: A SIMULATED PURCHASING DECISION USING DISCRETE CHOICE EXPERIMENTS

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ABSTRACT

This paper reports on the findings from discrete choice experiments designed to estimate farmers' perceived costs of land use restrictions, i.e. crop restrictions, additional fertilizing restrictions, and usage restrictions, as opposed to having no such restrictions. To this end, hypothetical land purchasing decisions were simulated based on the information about productivity, lot size, distance to other land, driving time to home, land use restrictions, and price. Farmers from the Campine area (Belgium) were invited to participate in the survey as the agricultural land in this region still faces the effects of historical heavy metal contamination resulting in crop restrictions. For identical pieces of land, we estimate the perceived cost, calculated as a change in the consumer surplus due to having a land use restriction, to be about 46,000 €/ha for the crop restriction, 50,000 €/ha for the usage restriction, and 70,000 €/ha for the fertilizing restrictions. Assuming this cost to represent a perpetuity, then with a discount rate of 5% the yearly fixed costs respectively equal about 2,300 €/ha, 2,500 €/ha, and 3,500 €/ha.

KEY WORDS

Farmland value; Land use restrictions; Perceived cost; Compensation; Support

HIGHLIGHTS

- We use choice experiments to simulate a hypothetical farmland purchasing situation
- We investigate the effect of land use restrictions on farmers' preferences
- We calculate farmers' perceived cost of farmland restrictions
- We find a yearly fixed costs of about 2300 €/ha for crop restrictions, 2500 €/ha for land usage restrictions and 3500 €/ha for fertilizing restrictions

1. Introduction

1.1. The joint provision of public and private goods

Land ownership allows the landowner to carry out a limited set of actions (Coase, 1960). Furthermore, if private land also provides significant public benefits, it can be seen as the government's role to reallocate property rights in order to maximize social welfare (Thomson and Whitby, 1976). Such a reallocation is often instigated by environmental protection and conservation. The Endangered Species Act of 1973 in the United States (US) is an example of the tension created by such regulation culminating in the question: 'Should compensation be paid for such reallocation of property rights?' (Blume et al., 1984; Polasky and Doremus, 1998; Smith and Shogren, 2002). Similarly, the European Common Agricultural Policy (CAP) has shown growing attention for environmental protection and sustainable agriculture since 1992 (European Commission, 2012). This trend has made direct payments to farmers conditional upon cross-compliance to conditions relating to the environment, food safety, and animal welfare also known as the statutory management requirements (SMR) and standards for good agricultural and environmental condition of land (GAEC) (European parliament and the Council, 2013a). This trend persists as the latest CAP reform puts the joint provision of public and private goods at the core of its policy. To support this change, a new support instrument has been created, accounting for 30% of the national direct payment envelope, called 'payment for agricultural practices beneficial for the climate and the environment' or in short 'green (direct) payments'. It targets farmers entitled to a payment under the basic payment scheme or the single area payment scheme. This instrument will be active from 2015 onwards and serves to support farmers for the public services their land is now obligated to provide. Specifically, the agricultural practices leading to public benefits include: (1) crop diversification, which aims at soil quality improvements, (2) permanent grasslands, which aim at carbon sequestration, and (3) ecological focus areas, which aim at biodiversity conservation. Consequently, the EU will be relying heavier on mandatory measures, while keeping the voluntary agri-environmental schemes alive in the second pillar (European Parliament and the Council, 2013b; European Union, 2013). Therefore, the situation of a reduction in private landowners' rights for the public's benefit will be encountered more often in the future.

1.2. The reallocation of property rights in the public's interest

The answer to the question 'Does such reallocation require compensation?' differs according to whom is giving the answer. In the European Union the private agricultural landowner is legally protected in most countries from the deprivation of possessions, including a nominal change in the degree of property rights. Our personal assessment based on the framework by Schutte (2004), who has listed the criteria of the European Court for Human Rights, provides little hope for farmers to be compensated for land-use restrictions such as those installed by the CAP out of legal motivations. Indeed, (1) whereas land-use restrictions are a deprivation of a possession (2) causing interference with the peaceful enjoyment of that possession (3) which is lawful in the EU as it is installed via regulations, (4) such land use controls are pursued in the public's interest as the scenery, the climate, and biodiversity are public goods, and (5) they strike a fair balance (i.e. the balance between the public's gains and the individuals' losses in property rights) given the fact that the policy is equal for all farmers and can be seen as solving a collective action problem (i.e. the misuse of a resource to which no one is inclined to stop first as others might benefit). Economic literature has mostly dealt with the debate of Kaldor-Hicks efficiency and effectiveness of such regulation. Nevertheless, Mullan et al. (2011) argue that if the new regulation is based on society's beliefs about what constitutes a public good, such as agricultural land, side payments may be a practical way to lower the transactions costs of implementing a change by overcoming resistance from those who stand to lose. Originally the European Council (1992) proposed measures to 'compensate farmers for any income losses caused by reductions in output and increases in costs and for the part they play in improving the environment'. Such payments can be justified from a social point of view if more friendly environmental practices lead to a growth in consumer surplus greater than the decrease in producer surplus, signaling that the Kaldor-Hicks efficiency criterion is fulfilled (Bonnieux et al., 1998). For an overview of the full set of tools policy makers have to their disposal in promoting the services public goods deliver, we refer to Van Zanten et al. (2014). In conclusion, the view taken here is that the payments, offered to farmers for complying with novel regulation, serve to decrease resistance from those that stand to lose.

1.3. Assessing the amount of compensation

Bateman (1996) found that farmers are more familiar with the concept of assessing potential compensation than households are with estimating hypothetical payments for increased provision of public goods. Still, mostly discrete choice experiments (DCEs) have been used to estimate societies' preferences and hence willingness to pay (WTP) for an increase in agricultural non-commodities (Campbell, 2007; Colombo et al., 2009; Garrod et al., 2012, 2014; Huber et al., 2011; Kallas et al., 2007; Scarpa et al., 2009). Nonetheless, DCEs have previously also been used to inform the design of (novel) payments to farmers intended to increase the provision or quality of non-market goods (see Table 1). Espinosa-Goded et al. (2010), Christensen et al.(2011), Broch et al. (2013), Beharry-Borg et al. (2013), Kaczan et al. (2013), and Greiner et al. (2014) have investigated farmers' willingness to accept (WTA) (novel) voluntary payment schemes. Alternatively, to the best of our knowledge, Schulz et al. (2014) are the first to have explored the prospective compliance with the mandatory greening of the CAP. They have estimated farmers' marginal WTA an increase in 'greening'. All studies mentioned above have the following in common. They used the additional payment following compliance or equivalent reduction in payment following noncompliance with a novel payment scheme as the price vehicle that allows calculating the WTA an increase in the provision of non-market goods by farmland.

Table 1: Literature review on DCEs valuing land use restrictions

Authors	**Goal**	**Scheme type***	**WTP/ WTA**	**Price Vehicle**	**Opt-out**
Ruto and Garrod (2009)	Compare design preferences of current participants and non-participants for a hypothetical payment scheme	Voluntary	WTP	Payment/ ha.year	Neither
Espinosa-Goded et al. (2010)	Calculate design change preferences of participants of a nitrogen fixing crop payment scheme	Voluntary	WTA	Payment/ ha.year	Current level
Christensen et al. (2011)	Calculate design preferences for a novel pesticide-free buffer zone payment scheme	Voluntary	WTA	Payment/ ha.year	Neither

Broch et al. (2013)	Calculate design preferences for a novel payment for ecosystem services (i.e; recreation, groundwater, and biodiversity) scheme	Voluntary	WTA	Single payment/ ha	Neither
Beharry-Borg et al. (2013)	Calculate design preferences for a novel water quality payment scheme	Voluntary	WTA	Additional payment/ ha.year	Neither
Kaczan et al. (2013)	Calculate design preferences for a novel anti-deforestation scheme	Voluntary	WTA	4 types	Neither
Greiner (2014)	Calculate design preferences for a novel biodiversity conservation payment scheme	Voluntary	WTA	Payment / ha.year	Neither
Schulz et al. (2014)	Calculate design preferences for a novel greening scheme including the share of ecological focus areas (EFA), the permissible use of EFA, and the location of EFA	Mandatory (Pillar I)	WTA	Reduction in payment/ ha.year	No compliance

* Scheme types are considered: (a) voluntary if the payments require contractual agreements to be made between parties and (b) mandatory if the payments (which are a necessity for the continuity of farmers' operations) depend on compliance with policy

Similar to the branch of literature revised above, it is our ambition to calculate the level of compensation required to motivate farmers to comply with the regulations of a payment scheme. Previously, mostly a change from a situation without additional restrictions (i.e. the real situation) to a situation with additional restrictions (i.e. the hypothetical situation) is considered. Here, we apply an approach in which a situation without any additional restrictions (i.e. the unaffected situation) is compared to a situation with additional restrictions to calculate the perceived cost estimates. Note that unaffected does not signal that there are no restrictions at all. It simply refers to the situation in which the three restrictions under study are simultaneously absent while other regulation is kept constant. In particular, we study land use restrictions motivated by water protection i.e. the fertilizing restriction (European Council, 1991), carbon sequestration i.e. the permanent pasture restriction (European Commission, 2009; European Parliament and the Council, 2013b), and food safety i.e. the crop type restriction (European Parliament and the Council, 2002). It should nevertheless be noted that the interpretation of the perceived cost estimate of crop restrictions differs from that of the usage and fertilizer restrictions. In the former case the farmer is the victim of a situation caused by the zinc smelters, whereas the usage restriction and fertilizer restriction are brought into life to prevent contributions to climate change and water pollution caused by farmers. Nevertheless, the attribute was included in the experiment due to the case study context and for comparison purposes. The height of the perceived cost of the crop restrictions attribute can serve as a measure of how much farmers having to cope with the crop restriction would like to be compensated at the time of surveying. A lump sum payment by the polluter would be the ideal solution in this case. In practice this ideal is unreachable as the polluter has ceased to exist as a legal entity. A second best could be the creation of a fund created by tax payer's money. However, agreeing with existing legislation we do not feel such compensation should be granted to the farmers if in reality they bought the polluted land at a price rebate and were aware or could have been aware that the rebate is due to the environmental stigma (Flemish Government, 2006). The fertilizer restriction and the usage restriction are actually part of an agricultural payment scheme. Hence, their matching perceived cost estimates can be interpreted as the amount farmers would like to be compensated by for installing such restrictions on an unaffected piece of land. Such payments could be offered to farmers for complying with novel regulation in order to decrease resistance from those that stand to lose.

In this paper, a methodology using DCEs, building on the work of Tegene et al. (1999) and Gelso et al. (2008), is put forward that allows calculating farmers' perceived cost of land use restrictions by comparing the difference in utility between buying a restricted parcel and buying an unaffected parcel (see equation 1). Such a calculation coincides with a change in consumer surplus, caused by the land use restrictions, which serves as an approximation of the compensating variation in logit models as originally proven by Small and Rosen (1981). In equation 1 the superscript *1* represents the situation with a restriction and the superscript *0* is the unaffected situation for respondent *n* and alternative *j* (Train, 2003).

$$\Delta E(CS_n) = \frac{1}{-\beta_{price}}\left[ln\left(\sum_{j=1}^{J^1} e^{V_{nj}^1}\right) - \ ln\left(\sum_{j=1}^{J^0} e^{V_{nj}^0}\right)\right] \quad (1)$$

The perceived cost, as defined here, is equal to the sum of both monetary (e.g. production income losses and transaction costs) and non-monetary costs (e.g. anxiety, reduction in freedom of choice) of installing such legislation. It thus represents the amount farmers would like to receive. The valuation was performed using DCEs motivated by the lack of available data for agricultural land prices. Hence, land use restrictions were embedded as an attribute in a discrete choice experiment simulating a purchasing decision as it was our goal to find out land use restrictions' impact on farmland value. Finding out how to (re)design a payment scheme is out of this study's scope. Finally, it should also be noted that expanding farm operations is also possible through rent and that using rental rates as the payment vehicle would result in entirely different appraisals of the perceived cost (Kaczan et al., 2013). We chose not to investigate the rental decision as in Flanders rental prices of agricultural land are regulated by the government. They cannot exceed a legal maximum level, whereas the latter is below the market price. The remainder of this paper is divided as follows. In the following section the DCEs method is described. In a third section, this method is applied on a case study undertaken in the Limburg Campine region of Belgium. In a fourth section, the results are discussed. Finally, the main findings are presented.

2. Methodology

2.1. Discrete choice experiments' elicitation mechanism and the estimation models used

In this manuscript, discrete choice experiments (DCEs) are adopted as a stated preference (SP) methodology. DCEs aim to identify individual's indirect utility function associated with attributes of goods or services by examining the tradeoffs they make when making choice decisions (Garrod and Willis, 1999). Therefore, multiple alternatives – described by several product characteristics or attributes with varying attribute levels – are presented to respondents in choice sets. The respondent is then asked to pick one single alternative from each choice set, thereby revealing his/her preference for certain attributes or attribute levels. Subsequently, the choices are econometrically analyzed in order to estimate attribute coefficients.

The microeconomic theory underlying DCEs is based on the notion that utility is derived from attributes of a particular good or situation, which was put forward by Lancaster (1966). His theory of consumer demand provides the basic conceptual structure for DCEs in an economic setting (Holmes and Adamowicz, 2003). Based on the conceptual foundation of random utility laid out by Thurstone (1927), McFadden (1974) expanded on the DCEs framework and developed an econometric model that formalized respondents' decision making process. This model is often referred to as the conditional logit (CL) model, which is considered to be the base model for DCEs (Hensher and Greene, 2003). The simplicity of its closed-form comes at a cost, given that the CL model translates the independent and identically distributed (IID) assumption into substitution patterns that are restricted by independence of irrelevant alternatives (IIA) (Tesfaye and Brouwer, 2012). This is an assumption which is often violated in social studies to which ours constitutes no exception. Mixed logit type models, such as the random parameter logit (RPL) and error component logit (ECL), fully relax the IIA assumption. These are models having unconditional probabilities P_{ij} equal to the integral of standard logit conditional probabilities $L_{ij}(\beta)$ over a density of parameters $f(\beta)$, see equation 2. The RPL model allows for coefficients to vary -and thus represent random taste variation- between decision makers according to a continuous distribution with a density $f(\beta|\emptyset)$, which is a function of other metrics $\emptyset$ (e.g. an unknown mean and covariance). Alternatively, a mixed logit model can be used as simply representing error components that create correlations among the utilities for different alternatives. This is called an error components logit (ECL) model. Here, an analog to the nested logit model can be obtained by specifying a dummy variable for each nest that equals 1 for each alternative in the nest and zero for alternatives outside the nest. It is convenient in this situation to specify the error components to be independently normally distributed ($N(0,\sigma^2)$). The variance then captures the magnitude of the correlation. In our case, there is only one nest, consisting of the three hypothetical alternatives (Train, 2003). It is likely that a cross-correlation exists between these alternatives, seeing that the opt-out, which is included in each choice set in order to mimic actual market behavior and increase familiarity with the setting (Kontoleon and Yabe, 2003), is often traded off against the remaining options (Scarpa et al., 2005).

$$P_{ij} = \int L_{ij}(\beta) * f(\beta) * d\beta \quad (2)$$

2.2. Setting up the discrete choice experiments

Generally, setting up discrete choice experiments requires seven steps (Garrod and Willis, 1999; Louviere et al., 2000). These steps are outlined in Table 2. The decision problem has been characterized in subsection 1.3. Steps 2 to 5 are handled below, while steps 6 and 7 are elaborated on in the Results section.

Table 2: Steps in setting up a discrete choice experiments study

Step	Action
1	Characterize the decision problem
2	Identify key attributes and attribute levels
3	Develop an experimental design
4	Design questionnaire survey
5	Pre-test and undertake survey
6	Estimate model
7	Interpret results

In light of the different steps required in setting up a DCEs study, Boerenbond – the largest farmer association in Flanders (Northern part of Belgium) – agreed to act as a sounding board and expert panel. Their sole function was to co-decide on the factors that influence a local farmer's purchasing decision, in return for their membership list. The resulting cooperation has allowed decreasing the cost of both attribute selection and data gathering, while its expense consisted of Boerenbond being given first-hand insight into the attribute coefficients. We decided on incorporating the following attributes in the DCEs simulating a purchasing decision based on two focus group meetings with Boerenbond's experts: location, lot size, price, soil productivity, and land use restrictions (see Table 3). The location attribute was subdivided into two independent attributes, one that indicates the driving time by tractor from their home to the parcel and one that indicates how far the parcel is located from other farmland that is cultivated by the farmer. Consequently, we included six attributes in the DCEs. Note that the complexity of the DCEs goes side by side with the number of attributes (Caussade et al., 2005). Evidence for including these attributes is also found in literature. Numerous studies have analyzed prices to identify the principal factors determining land values of agricultural and urban land. The classical vision on agricultural land values is that prices equal the present value of the expected stream of rents produced by the land and hence differences in values correspond to productivity differentials (Freeman III, 2003). This warrants the inclusion of the attributes soil productivity and parcel size in the DCEs. Xu et al. (1993) have previously included these features in a hedonic pricing study measuring the contributions of site characteristics to the value of agricultural land. Economic theory also suggests that access to transportation may play an important role in determining agricultural land value seeing that it provides farmers with access

Table 3: Farmland attributes and levels

Attribute	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Lot size (ha)	0.5	1.5	2.5	3.5
Soil productivity	Low	Rather low	Rather high	High
Driving time to home (min)	5	10	15	20
Distance to other land (km)	0	0.750	1.500	2.250
Land use restrictions	None	Crop restriction: No arable crops and vegetables due to soil contamination	Fertilizer restriction: 25% less usage of fertilizers	Usage restriction: Permanent pasture
Price (€ ha^{-1})	15,000	25,000	35,000	45,000

to markets and reduces input costs. This finding supports the inclusion of the location-based attributes, i.e. driving time to home and distance to other farmland. Johnston et al. (2001) have previously included these characteristics in a hedonic pricing study estimating the amenity benefits of coastal farmland. Grammatikopoulou et al. (2012) have shown that distance is an important factor in land use decisions. The classical vision on agricultural land value only holds true for perfect markets, which the land market is not. Hence, pleas were made for more complex models (Clark et al., 1993). Land value literature has shown that institutional factors, i.e. effects of various types of policy, play a role. Most relevant to our case is that evidence has also been found of the influence which operational restrictions, motivated by the demand for environmental protection, may have on agricultural land values (Nickerson and Lynch, 2001; Vukina and Wossink, 2000). This supports the inclusion of three land use restrictions, which are most relevant to farmers living in the case study region according to Boerenbond. As noted in section 1.3., the level 'none' refers to the situation in which the restrictions under study are simultaneously absent while other regulation is kept constant. A price vehicle has to be included to translate utility into monetary equivalents.

Each attribute was assigned four levels, which aimed to reflect the farmland market in the Campine region as closely as possible. For three continuous variables – i.e. price, lot size and driving time to home – level allocation was based on the distribution of these variables from actual purchases over the period 2004-2011 (Adamowicz et al., 1994). Information on the distribution of these variables can be found in Table 4. For the price variable, 15% of the observations were found to deal with real sales prices lower than 15,000 €/ha. However, this is partly due to sales transactions in nature area and partly due to the extensive time range 2004-2011 of the dataset. At the time the survey was administered (December 2012 - February 2013), farmland prices below 15.000 and above 45.000 €/ha can be considered as exceptional in the area. The average real price in Flanders in 2009 and the average perceived price of land held in

Table 4: Distribution of the variables from real purchases

	Price		**Lot size**		**Distance to home**	
	Level (€ ha^{-1})	Percentile	Level (ha)	Percentile	Level (km)	Percentile
Lower range	15,000	15th	0.5	40th	0	15th
Upper range	45,000	92th	3.5	94th	7	95th

the study region is respectively about €28.300/ha (Bergen, 2011) and €32.000/ha. With regard to lot size, the dataset included a vast amount of very small parcels, some of which we suspect were intended for residential purposes. Recognizing that this influences the mean, the average lot size was found to be about 1.5 ha. The driving time to home was estimated using GIS. Assuming a tractor drives at an average speed of 20 km/h, it will have travelled about 7 km in 20 minutes. Parcels at zero driving time were disregarded, because we assumed it to be highly likely that such a parcel is currently owned by the respondent and as such constitutes an unrealistic choice option. Family sales are outside this study’s scope, while it should be recognized that personal relationships are an inherent part of farmland transactions which have a significant depreciating effect on sales prices (Tsoodle et al., 2006). Since no information was available on the distance to other farmland in the sales data, these attributes were assigned levels on the basis of expert opinions in both focus groups. The non-numeric attributes, i.e. soil productivity and land use restrictions, are dummy coded. The attribute ‘land use restrictions’ uses ‘none’ as the base level, while “high productivity” was used as the base level for the attribute “soil productivity”. Being a qualitative attribute, we acknowledge that the soil productivity is open to heterogeneity. However, we have tried to fix this attribute to be homogeneous by creating a relative judgment. The soil productivity attribute was defined as the productivity of the hypothetical parcel compared to other parcels in its vicinity. A relative judgment simultaneously offers the advantage of being able to survey several types of farmers, which have differing notions of productivity in mind. We have done so seeing that Campine region is considered of being an ‘agricultural area’ due to the homogeneity of its soil characteristics. Finally, we admit that whereas the land use restrictions under study can occur simultaneously, in this work they are assumed to be mutually exclusive. This assumption, nevertheless, allows calculating the perceived cost of a single land use restriction versus no such restrictions. We acknowledge that by doing so information is lost about the difference between degrees of freedom, however, it keeps the amount of attributes more manageable for respondents.

The next step in setting up DCEs involves developing an experimental design. Given that 6 attributes are included in the design, each with 4 attribute levels, 4096 possible profiles exist. Consequently, a generic fractional factorial design is created to reduce the amount of choice sets presented to the respondents. In this study, a main effects, D-efficient utility neutral design for a MNL model was created using SAS. The prevailing argument for selecting a D-efficient design over an orthogonal design is the minimization of standard errors on parameter estimates, which allows for smaller sample sizes (Bliemer and Rose, 2011). This resulted in a design consisting of 16 choice sets, which was blocked over two surveys in order to reduce respondent fatigue. The choice sets in each block were randomized five times to counter order effect bias (Day et al., 2012). Per choice set, three hypothetical parcels and an opt-out were offered to farmers. An example of a choice set is provided in Table 5.

Table 5: Choice set example

	Option A	**Option B**	**Option C**	
Lot size	2.5 ha	3.5 ha	1.5 ha	
Soil productivity	High	Rather low	Rather high	
Driving time to home	15 min	20 min	5 min	I do not wish to buy any of the former; I would refrain from expanding
Distance to other land	2.250 km	0.750 km	0 km	
Land use restrictions	None	No arable crops and vegetables due to soil contamination	25% less usage of fertilizers	
Price	45,000 €/ha	25,000 €/ha	15,000 €/ha	
Choice	O	O	O	O

Subsequently, both blocks were inserted in the survey, which was designed to fit the guidelines provided by (Bateman et al., 2002): (1) Survey purpose, (2) Farm-level questions, (3) Attitudinal/motivational questions, (4) Choice sets, and (5) Socio-economic questions. The second section in the survey contained questions about the agricultural activities of the farmer and the farm's land allocation. The third section included statements that assessed their risk attitude and environmental awareness. The survey was pre-tested in both focus groups as well as in a subsample of 6 farmers in the area. The goal was to verify their understanding, not to improve or test the experimental design.

The final decision to be made concerns the distribution method. There are only two modes of administration suitable for discrete choice experiments, i.e. in-person interviews or computer-assisted surveys. In this study, the in-person option by means of non-Boerenbond affiliated surveyors was preferred because of two major arguments. Although in-person interviews are time consuming, this distribution method produces high quality data in which the amount of missing data is strongly reduced. Moreover, it enables the interviewers to provide the respondents with extra information in order to clarify the objective and the interpretation of certain questions. Secondly, given that mail questionnaires have the lowest response rates of all survey methods (Champ, 2003) and the amount of farmers in the study area is rather limited (N=1560), this method might return a too small sample of respondents. We received contact information for Boerenbond members in all municipalities that were located for at least 50% (of surface area) in the Campine region. This list was used as a sampling list for contacting respondents. This list was corrected by Boerenbond to exclude farmers that were classified as having a very limited amount of agricultural activities. The final sampling list only contained 684 addresses and telephone numbers from farmers living in the study area. Respondents were selected by simple random sampling from the contact list. Farmers were first contacted by telephone to briefly explain the nature and the objectives of this research, after which they were asked whether they were willing to participate in the study. If the respondent agreed to cooperate, an appropriate date and time was arranged for an in-person interview.

2.3. The case study area

In Figure 1 the municipalities in the case study area are displayed on a map of Belgium in which the Campine region is the brown area. Our research area covers solely municipalities located in the Limburg province. According to the agricultural census there was 35788 ha of land in cultivation in the area in 2012 (FOD Economie, 2013a). The farmers in our survey cultivate roughly 10000 hectare, hence about 28% of the agricultural surface was covered. Large agricultural areas in the Campine region are contaminated with cadmium (Cd), lead (Pb), and zinc (Zn) caused by historical pollution. The contamination was caused by thermal zinc smelters, indicated on Figure 1. Although the latter have stopped emitting anomalous elements in the 1980s, soil Cd concentrations remain higher than allowed in a number of places throughout the area. This has frequently led to confiscation of food and feed, because their contents exceed the legal threshold values for cadmium (Witters et al., 2009).

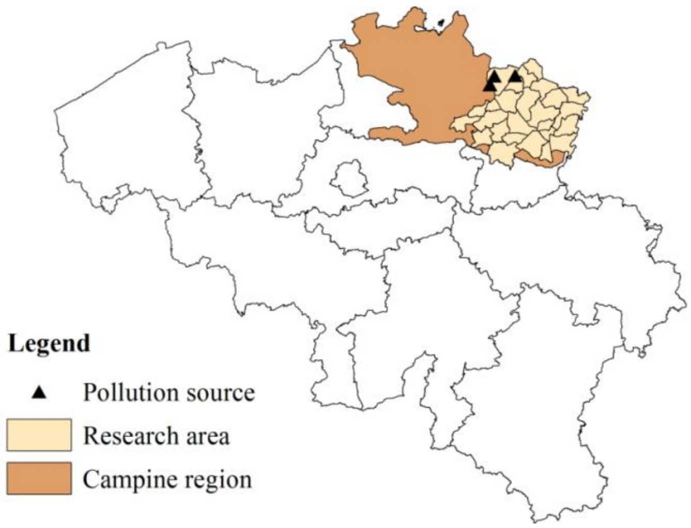

Figure 1: Case study area

3. Results

3.1. Descriptive statistics

The survey was completed by 188 farmers. A high response rate of 67% was obtained. Presuming the census includes the complete population of farmers, it can be examined whether the sample in this study represents the farming population in the entire Campine region. In Table 6 the socio-economic characteristics of the sample and population are displayed. It can be observed that the sample includes more male farmers that are considerably younger than the population. This can partly be explained by the inclusion of all farmers with some agricultural activities in the census, while our sampling list was corrected for farmers with a minimal amount of farming operations. The fact that almost 21% of the farmer population is older than 65 confirms that the census includes a significant amount of retired farmers. The farm level characteristics also show that our sample includes more active, professional farmers. 98% of the sample are full time farmers, while the census indicates that merely 69% of the farming population is employed full time. In the category of farmers over 50 years old, the sample contains substantially more farmers with a successor in comparison with the entire population. The underrepresentation of older farmers in the sample might also be explained by the study's set-up. Older farmers without successor are often not interested in investing in purchasing farmland anymore. Consequently, these farmers often refused to participate in the survey.

Table 6: Descriptive statistics

Characteristics		**Sample (n=188)**	**Population (n=4351)**
Sex of farm manager	Male	95.5%	86.21%
	Female	4.5%	13.79%
Age of farm manager	>35	6.5%	4.55%
	35-44	18%	18.21%
	45-54	58%	37.37%
	55-64	14%	18.97%
	>65	3.5%	20.9%
Employment	Full time	98%	68.59%
	Part time	2%	31.41%
Successor (age>50)	Yes	33%	10%
	No	47%	61%
	Not sure	20%	29%

With respect to farming types, the census only reports general percentages on farms' activities and does not report on the main activities in the area. Therefore, the sample cannot be compared to the population on the basis of farming types. The sample primarily includes specialist farms (see Table 7). A farm is considered as specialist if at least two thirds of the farm's gross margin emanates from one agricultural activity. The sample particularly includes three types of farming, i.e. specialist dairy farms, specialist pig farms and mixed farms. However, the sample is clearly dominated by specialist dairy farmers. Hence, it should be noted that the Campine region has by far the largest amount of dairy cows per company of all Belgian agricultural areas (FOD Economie, 2013a). Moreover, the Campine region also has a high amount (>1.1) of dairy cows per ha according to FADN data (2007).

Table 7: Farming types

Farming type	Percentage
Specialist farms:	79,5%:
Field crops	2%
Milk	56,5%
Pig	10%
Grazing livestock	4,5%
Vegetables	1,5%
Fruits	3%
Other	2%
Mixed farms	20,5%

3.2. Results analysis: data inspection and model estimation

As a first step in results analysis, the choice data must be inspected. This revealed that not a single respondent chose the opt-out in all 8 choice sets. However, the opt-out was chosen in about 12% of the times over all respondents and was used at least once by about half of the respondents. The lack of farmers, which consistently opted out, can be explained by the study's set up. Farmers uninterested in purchasing land refused to participate in the survey thus avoiding the need to delete their protest answers afterwards. As shown in section 3.1., this approach has led to an overrepresentation of both young, professional farmers and older farmers having a successor compared to the population.

Being good practice in model estimation, a simple CL model was estimated in order to obtain a general insight into the results and potential sources of observed heterogeneity (Hensher et al., 2005). The quantitative attributes were coded using their respective levels. For the qualitative attributes, i.e. soil productivity and land use restrictions, the levels 'high productivity' and 'none' were used as base levels. An ASC for the opt-out option is included in the analysis. Following Holmes and Adamowicz (2003), each attribute level of the opt-out alternative was handled using zeros. The results of the CL model are omitted, because -as was expected- the IIA assumption was proven to be violated. Mixed logit type models fully relax the IIA assumption without having to adopt different distributions for the error terms or different structures in decision making. Subsequently, a random parameter logit (RPL) and an error component logit (ECL) model were estimated. These models respectively allow identifying whether heterogeneity is present and verifying whether significant correlation between alternatives is present. In the RPL model all parameters, except price, were assumed to have a normal distribution. Previous investigation has shown that an experimental design intended for a CL may be reused with limited efficiency loss for the estimation of a panel-based RPL model (Bliemer and Rose, 2010). The results can be found in Table 8. The main effects' coefficients show that the presence of soil contamination and the resulting crop restrictions reduce farmland utility at the 1% level in comparison with the base level in which none of the three land use restrictions under study are applied. The average farmer prefers parcels of farmland that are not affected by soil contamination. A similar negative value was found for the usage restriction originating from the permanent pasture obligation. A more negative value was derived for the fertilizing restriction, which indicates that the average farmer is even less likely to select a parcel of farmland that has such restrictions. All other attribute (level) coefficients exhibit the expected sign. The lot size attribute indicates that the average respondent is more attracted to larger pieces of farmland. Lots with lower productivity are disliked. However, in comparison with the high productivity base level farmers do not expect to experience significantly less utility from a parcel that is labeled as having a rather high productivity. The results also reveal that farmers are less likely to buy farmland which is located further away from the farmer's home or from other parcels in the farmer's cultivation area. Finally, the negative coefficient for the ASC points out that choosing the opt-out option provides significantly less utility to respondents in comparison with selecting one of the three hypothetical farmland alternatives. These findings are identical in both model specifications. Marginal WTP estimates for the average respondent can easily be computed as they are equal to the ratio of a main effects' coefficient and the price vehicle. A ranking can be made indicating attribute importance by: (1) calculating the utility range per attribute; (2) summing the utility ranges, and (3) dividing the attribute utility range by the sum of the utility ranges (Lizin et al., 2012). This showed that the attribute importance ranked from high to low is: land use restrictions, productivity, price, lot size, distance to other land, driving time. Regarding heterogeneity in parameter estimates, the RPL model indicates that there are a number of attribute(s) (levels) with unobserved heterogeneity as shown by the significant standard deviation. More specifically, the respondents seem to have divergent preferences with respect to the attributes lot size, distance to other farmland, driving time to home, and all three of the land use restrictions. This finding does not change by including

Table 8: Results of the RPL and ECL model

	RPL		ECL	
	Coeff.	**Std. err.**	**Coeff.**	**Std. err.**
Main effects				
Lot size (ha)	0.108^{***}	0.300	0.108^{***}	0.027
Low productivity	-0.559^{***}	0.085	-0.542^{***}	0.083
Rather low productivity	-0.558^{***}	0.092	-0.512^{***}	0.085
Rather high productivity	-0.052	0.093	-0.058	0.081
Driving time to home (min)	-0.012^{**}	0.006	-0.011^{**}	0.005
Distance to other land (km)	-0.090^{**}	0.04	-0.082^{**}	0.040
Crop restriction	-0.423^{***}	0.104	-0.369^{***}	0.081
Usage restriction	-0.481^{***}	0.117	-0.397^{***}	0.084
Fertilizing restriction	-0.673^{***}	0.121	-0.559^{***}	0.090
Price (€/ha)	$-1*10^{-5***}$	$3*10^{-6}$	$-8*10^{-6***}$	$2*10^{-6}$
ASC	-1.875^{***}	0.213	-2.247^{***}	0.230
Standard deviations				
Lot size	0.219^{***}	0.040	/	/
Distance to other farmland	0.0002^{***}	0.00006	/	/
Driving time to home	0.027^{***}	0.009	/	/
Crop restriction	0.447^{***}	0.148	/	/
Fertilizing restriction	0.650^{***}	0.143	/	/
Usage restriction	0.427^{**}	0.177	/	/
Error component	/	/	-1.267^{***}	0.170
Pseudo R²	0.081		0.084	
Log likelihood	--1915.28		-1909.31	

*, **, *** represents significance at 10%, 5%, and 1% level

interaction effects, which represent observed heterogeneity. Correlation between the hypothetical alternatives was confirmed as a significant error component was identified. Seeing that the ECL has the highest log likelihood with fewer parameters, it is the model providing the best fit for our data based on a likelihood ratio test (Ben-Akiva and Swait, 1986). In case these models were not nested, one can still turn to the Akaike Information Criterion (AIC). For our data the lowest AIC is found for the ECL as such reconfirming the results of the likelihood ratio test. Consequently, the perceived cost of each of the land use restrictions is calculated based on the results of this model and equation 1, which represents how to calculate a change in consumer surplus for logit models. For identical pieces of land, this formula estimates the perceived cost for an average respondent to be 46125€/ha for the crop restriction, 49625€/ha for the usage restriction, and 69875€/ha for the fertilizing restrictions. Note that these costs have an infinite time horizon. If we assume this cost to represent a perpetuity, then with a discount rate of 5% the yearly fixed costs respectively equal 2306 €/ha, 2481 €/ha, and 3494 €/ha.

4. Discussion

Previous work has mostly estimated farmers' willingness to participate (-respectively WTA-) in payment schemes, be it voluntary or mandatory, with a focus on investigating the impact of payment scheme characteristics, e.g. contract duration and flexibility, on farmers' intention of participating in a payment scheme envisioning a single goal. In spite of these differences, conclusions were inferred that are useful in the light of our own results. A highly consistent finding was that some farmers appear willing to sign up to payment schemes for modest levels of compensation, whilst other farmers are extremely resistant to participating (Ruto and Garrod 2009; Espinosa-Goded et al. 2010; Christensen et al. 2011; Beharry-Borg et al. 2013). Furthermore, Christensen et al. (2011) concluded that the overall flexibility of the contract might be more important to farmers than the practical restrictions in flexibility that a contract induces. Hence, the lack of overall flexibility going side by side with regulation might have influenced our results, as such reconfirming the statement by Espinosa-Goded et al. (2010) which articulated the need for higher compensation in case of compulsory measures. In this regard it should be noted that Beharry-Borg et al. (2013) found that the average compensation required to persuade farmers to participate in a voluntary scheme installing a 25% reduction on farmyard manure equals 20£/acre/year or 65 €/ha/year (using a 1.3 €/£ conversion rate) over a five to ten year period for a sample of farmers from a region where farming is predominantly extensive sheep and cattle rearing, with dairy being important locally. It is hence difficult to compare our estimates with the ones presented in literature. Nevertheless, the latter authors also found that specialist cattle and/or dairy farmers are more averse to making 25 and 50% reductions in farmyard manure applications than other farmers. Similarly, Schulz et al. (2014) revealed that highly intensive dairy farms perceive it to be significantly harder to cope with greening than their less intensive counterparts. Our study is hence in line with the qualitative findings of previous studies that have investigated (the heterogeneity in preferences for) land use restrictions when acknowledging that our results provides intuitions that are most appropriate for specialized dairy farmers. One reason for the overrepresentation of dairy farmers might be that the sampling frame provided by Boerenbond was overrepresented by dairy farmers, especially after correcting for very small farms. Unfortunately, farm type information was not included in the membership list due to privacy reasons, so this could not be verified. Another reason might be that dairy farmers, bearing the abolition of the milk quota's in mind, are most concerned with land purchasing decisions at the moment in order to comply with the strict fertilizing conditions in Flanders. The data confirm that dairy farmers are highly represented (i.e. 83%) in farm types that have bought more land than the average farm in the last 5 years. Compliance with regulation was found as one of the key drivers for purchasing land as was increasing the scale of operations. On top, farming activities on the sandy soils of the Campine region also have to respect a more tight fertilization norm due to the higher risk of leaching compared to other areas (VLM and Mestbank, 2011). Hence, the combination of dairy farmers' productivist attitudes and the trend of tightened fertilization norms might contribute to the perceived cost estimates. Indeed, attribute weights have been found to differ in function of the envisioned land use (Grammatikopoulou et al., 2012). Thus, although being counterintuitive to compensations based on forgone income, for the reasons mentioned above our results are understandable in a Flemish context.

Compensation demands of specialist dairy farms are also revealed in the actual market. The average direct support (Pillar 1) that farmers received in Flanders in 2012 was 10.065€ (Peeters, 2013). Having an available surface of 620.101 ha and 25.258 companies (FOD Economie, 2013b), the average direct support per ha per annum roughly equaled 410€. No such data is available which is tailored to the case study region. Still, it should be noted that full-time dairy farmers, which constitute the majority in our sample, have received above average levels of direct support -by at least 40%- in the past (Van der Straeten et al., 2013). Rural development (Pillar 2) is a second channel that offers support for farmers voluntarily undertaking certain pro-environmental actions. Novel voluntary agreements have been proposed by the competent authority, i.e. the Flemish Land Agency , and are available as of 01/01/2015 under the limiting condition of approval by the European Commission. These agreements, which are financed by Flanders and the EU, offer payments that are now based on average lost income and transaction costs. For instance, a reduction in fertilization to reach a nitrate residue level of 4kg lower than the threshold value proposed by Flemish legislation would be compensated by about 1000 €/ha.year for grassland in Natura 2000 areas for a five year period (VLM, n.d.). Note that a fertilizing restriction on grassland for dairy farmers may not only lead to less feed but also to an increase in required manure spreading area. The latter loss is not being valued at the moment.

Moreover, a third channel are payments financed by Flanders. Support is also provided by the Flemish Land Agency for certain pro-environmental measures based on average lost income and transaction costs. For instance, if cropland were to be converted to permanent pasture aiming at biodiversity conservation, farmers would be compensated by about 1200 €/ha.year (VLM, n.d.). Admittedly, these estimates do not take into account farmers' reluctance towards change or any other non-rational mindset that might influence preferences as shown by Howley et al. (2015) Moreover, it also does not take into account their loss of options to diversify their operational risk, whereas our estimates for the usage restriction do. Similar arguments for discrepancies between the revealed compensation and perceived cost estimates have been argued for (Schulz et al., 2014).

Nevertheless, we cannot exclude the possibility that the perceived cost estimates are high due to the used method. The perceived necessity of buying land in order to comply with regulation might have led farmers to act strategically, in spite of our plea to take into account their budget constraint and lack of referral to policy consequences of our study, leading to inflated perceived cost estimates. Participants might have acted strategically in an effort to skew results and as such exert pressure on any program influenced by the survey's findings. Finally, it is possible - although we are dealing with average sized DCEs and a familiar good- that complexity might be an issue leading to decision making heuristics being used instead of the rational behavior which our estimation models assume. Attribute non-attendance, for instance, has been shown to affect the welfare estimates (Hensher et al., 2005b; Kragt, 2013; Scarpa et al., 2013).

5. Conclusion

This paper aimed to investigate the perceived cost of having land use restrictions on agricultural land. To quantify these costs, land use restrictions were embedded in a hypothetical purchasing situation by means of DCEs. 188 farmers in the Limburg Campine area were surveyed if they agreed to cooperate after being contacted. This allowed us to quantify farmers' preferences for the following attributes: driving time to home, distance to other farmland, lot size, productivity, land use restrictions, and price. To do so, the RPL and ECL model were used as they are not subject to the IIA assumption. The latter model was found to provide the best fit to our data. For identical pieces of land, this model estimates the perceived cost, calculated as a change in the consumer surplus due to having a land use restriction, to be 46,125€/ha for the crop restriction, 49,625€/ha for the usage restriction, and 69,875€/ha for the fertilizing restrictions. Assuming this cost to represent a perpetuity, than with a discount rate of 5% the yearly fixed costs respectively equal 2,306 €/ha, 2,481 €/ha, and 3,494 €/ha. This means that the average in-sample farmer would like to be compensated by 2,306 €/ha.year by the zinc smelters for the regulatory effects the pollution has caused now. To the best of our knowledge, we are the first to calculate the compensation required for the damage caused. We would like to remind the reader that we do not feel such compensation should be granted to farmers if in reality they bought the polluted land at a price rebate and were aware or could have been aware that the rebate is due to the environmental stigma. Alternatively, the average in-sample farmer would like to be compensated by 2,481 €/ha, and 3,494 €/ha for converting unaffected land to permanent pasture and for a 25% decrease in fertilization as opposed to the current legislation. These amounts represent the side-payments necessary to avert resistance from those that stand to lose. Bearing the Kaldor-Hicks efficiency principle in mind, such support levels do not have to be realized. It can be agreed upon to provide lower levels. However, the option to perform this transfer should be existing if regulation enhances welfare. Hence, it could be verified whether the public's benefits are greater than farmers' perceived costs. Additionally, whereas these estimates may seem high, we have identified the following arguments in favor of their realism. First, the sample is biased towards full-time specialist dairy farmers, which have been shown to be reluctant towards greening and fertilization restrictions in the DCEs literature. Second, specialist dairy farmers may be on the lookout for land which allows them to comply with tightening fertilizing norms -which are even tighter in the Campine area because of its sandy soils and hence leaching risk- while expanding their operations in view of the abolition of the milk quota. Third, perceived cost estimates are expected to be higher for inflexible payment schemes. Fourth, the perceived cost estimates are higher, but still in the same order of magnitude as the estimates based on lost income and transaction costs. Fifth, the perceived cost estimates represent the compensation or support that farmers would like to receive and hence also incorporate the valuation of non-market costs such as the joy from working the land. Still, we cannot exclude the possibility that the estimates might be inflated because of strategic behavior or complexity issues. Nevertheless, based on our findings policy makers are advised to take into account farm type differences instead of relying on current calculations based on average estimates of lost production income and transaction costs. Our findings show that dairy farmers perceive fertilizing restrictions more burdensome than usage or crop restrictions, whereas support levels based on average lost income and transaction costs point towards the opposite conclusion.

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