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Stability of the WTP measurements with successive use of choice experiments method and multiple programmes method

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Stabilité des mesures de consentement à payer avec l'emploi successif de la méthode des choix expérimentaux et de la méthode des programmes

Résumé

Ce travail s'insère dans une démarche d'identification des bénéfices des politiques paysagères qui privilégient, pour une zone géographique donnée (ici les Monts d'Arrée en Bretagne), certains attributs paysagers. Nous expérimentons une procédure appuyée sur un double dispositif d'investigation. Le premier, basé sur la méthode des choix expérimentaux s'attache à chaque attribut. En l'absence d'information préalable sur les relations de complémentarité – substituabilité entre attributs, nous travaillons sur la base de scénarii construits pour assurer l'indépendance des différents attributs. La question importante de l'effet de la variation d'un attribut sur la valeur esthétique d'un autre attribut lorsque ces attributs sont perçus de manière conjointe est alors abordée à travers une approche par la méthode des programmes multiples. Les deux enquêtes ont été réalisées à un an d'intervalle, par tirage d'échantillon à enquêter, auprès de la même population. Les résultats en matière de consentement à payer obtenus avec l'une et l'autre méthode se révèlent non statistiquement différents.

Mots-clés : Evaluation monétaire ; modélisation du choix ; approche multi-attributs ; méthode multi-programmes ; choix expérimentaux ; paysage ; Monts d'Arrée

Stability of the WTP measurements with successive use of choice experiments method and multiple programmes method

Abstract

This paper is part of an investigation to evaluate the benefits of landscape policies. Such policies are, within a specific area (here the Monts d'Arrée in Brittany), favouring some landscape attributes. We test out a procedure based on a double device. The first one relies on the choice experiments method and focuses on each attribute. Without prior information about the presence of substitution and complementarity effects between attributes, we work on the basis of scenarios built to ensure the independence of attributes. The important question of the impact of an attribute variation on the aesthetic value of another one, when these attributes are jointly perceived, is tackled by use of the multi-programme method. The two surveys were launched after an interval of one year, sampling among the same population. The WTP results obtained from each method are not statistically different.

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Key words: Valuation; choice modelling; multi-attributes choice set; multi-programme method; choice experiments; landscape; Monts d'Arrée

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Introduction*

The use of direct valuation methods based on stated preferences are required to address a great many issues relating to the environment and natural heritage. Contingent valuation method (CVM) appeared as the first technical and methodological response. Even now it remains a widely used system, but the need to go beyond some of its limitations has led to other methods being promoted. A key factor was the need to look further than the exclusively dichotomous nature of the situations addressed. In particular, the possibility of looking at certain natural assets, not so much globally as at their individual attributes, has led to the development of methods based on the theory of the characteristics [Lancaster, 1966]. The combination of this theoretical standard and the random utility theory (Manski [1977]), (Hanemann [1984]) has turned out to be highly fertile. It has given birth to a technique called the choice experiments method (CEM). This is essentially a structured method to generate information in order to reveal the factors that influence choice. We used this approach to appraise the value of three landscape attributes of the Monts d'Arrée in the Regional Natural Park of Armorique (Brittany).

However, in the absence of prior information about the complementarity-substitutability relationships between attributes, the implementation of this technique means, for practical reasons, the necessary independence of the different attributes selected. Although this approach reveals the value attached to each level of attribute taken in isolation, it neglects the important question of the effect of variation of an attribute on the value given to another attribute. To identify this type of effect, we started a further enquiry on the main-home residents of the study zone using a sequential approach in multi-programme terms (MPM) in the same way as the works by (Hoehn [1991]) and (Santos [1998]).

An examination of the literature shows works, which, for identical situations, compare the CVM and the CEM or the CVM and the MPM. However, we did not find any trace of research comparing the results of the CEM and the MPM as proposed by our contribution. It can also be observed that valuation using protocols inspired by the multi-programme valuation method or the choice experiments method often appear under similar appellations (Hailu *et al.* [2000]). Therefore, before presenting the application and results of our fieldworks, we will provide a reminder of the common principles and the specific features of the two methods and will show their relevance in the framework of landscape valuations.

1- Overview of the two methods and the landscape valuation context

Both methods are based on a rigorous theoretical framework and benefit from progress achieved in the econometric approach. They are particularly well suited to the economic valuation of public landscaping actions.

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1.1 Choice experiments method

The choice experiments (CEM) method is one that was developed in the field of transport and marketing economics (Louviere and Woodworth [1983]). It was then extended to environmental matters in the 1990s at the initiative of Adamowicz et al. [1994] with regard to recreation values, then to address the passive use values of environmental goods such as forests (Adamowicz et al. [1998]), wetlands (Morrison et al. [1998]) or forest landscapes (Hanley et al. [1998a], Hanley et al. [1998b]). Since then, its application to environmental evaluation has become widespread.

The environmental goods under consideration are broken down into their main attributes, using the Lancaster principle according to which it is not the goods themselves which provide satisfaction to the consumer but their characteristics or attributes (Lancaster [1971]). These quantitative or qualitative attributes themselves present a number of possible quality levels. The combination of the various attributes of the goods and their different levels will create a set of possible states, called "scenarios". In order to take account of the budgetary constraint of individuals in the preferences they express, a monetary attribute is integrated into the analysis and can also take on several levels. This price indicates the extra cost that the individual would bear in order to be able to benefit from the goods in the corresponding state. The different hypothetical scenarios are then associated two by two in "choice sets", each of which constitutes a situation of choice proposed to the respondents. A scenario called status quo, indicating a situation of non-intervention by the public actors and therefore nil cost, is integrated into each choice set to allow the surveyed person to opt for a choice other than the evolution scenarios imposed on him or her.

The generation process used to build such choice experiments is a fractional factorial design (Zwerina et al. [1996]) based on the orthogonality between the levels of attributes within the same scenario and between the pairs of scenarios forming a choice set. For practical reasons, this process is partial. The combinations are sorted according to a number of criteria. Indeed, the presentation of all the possible combinations would lead to an extremely difficult valuation exercise in cognitive terms. Usually, the smallest efficient experiment protocol is sought (Dachary-Bernard [2005]). This protocol gives the main effects of the attributes on the choice and leaves to one side the evaluation of the impact of interactions between attributes, as this would require more scenarios to assess. The omission of these interactions thus supposes that they do not explain the choice of the scenario. This may cause biases in the estimation if it turns out that they actually play a role in the choice process. However, a linear model already gives between 75% and 90% of explained variance (Louviere et al. [2000, p.94]). Next, the individuals' willingness to pay is inferred using the results of the estimation of the choice model according to the levels of landscape attributes in order to infer the utility value, and the monetary attribute parameter applying the formula proposed by (Hanemann [1984]).

1.2 Multi-programme method

The multi-programmes method (MPM) was set up to test the presence or otherwise of *the inclusion effect* as presented by Hoehn [1991]. According to the author, the set-up of a programme increases the level of utility of the individual, which is interpreted as a positive effect on his or her revenue. Consequently, the valuation of a supplementary programme, given that the first has already been put in place, takes two effects into account: (i) the direct effect on the utility of this new programme as a complement to or a substitute for the previous programme, and (ii) the revenue-effect following the set-up of the first programme. The first effect may be negative or positive depending on whether the two programmes are substitutes or complements in the utility function, while in the second it is negative. Two complementary programmes in the utility function of the individual may be substitutable in the valuation when the revenue-effect is higher than the direct effect. The author deduces that, the substitution effect occurs irrespective of the context in which the valuation takes place, owing to the mathematical structure of the optimisation problem of the consumer (Hoehn [1991] p. 293,). In line with the theoretical framework supplied by the author, to take account of the inclusion effect, several contributions have implemented a multi-programme valuation procedure. In the ascending version (Hoehn [1991]), a first programme is presented to be valued in relation to the status quo situation, to which is then added a second programme to be valued jointly with the first, etc., until the last programme is added. The reverse order can also be followed (descending version), starting with all the programmes. Each of the successive combinations is then valued comparatively to a common reference situation (Powe and Bateman [2003]) (Santos [1998]). More recently, the experimental tests conducted by Bateman *et al.* [2004] show that, in this sequential valuation procedure, the scale of the inclusion effects depends on the type of procedure implemented. Only the procedure whereby the information about the final scale of the public intervention (number of programmes considered) and the sequential nature of the procedure is first communicated to the person surveyed seems to give results that are stable when the orders of programme presentations are manipulated (increasing/decreasing).

The inference of willingness to pay is achieved via the estimation of the choice model of accepting or not the programme scenario presented in comparison to the reference situation, according to the socioeconomic characteristics of the people surveyed and the amount of the bid. The multi-programme method therefore shares a number of characterisitcs with the CEM method since it is also based, on the conceptual level, on a multi-attribute approach to goods or services to be valued by matching the notion of *programme* with the notion of *attribute*. However, they do not have the same objective. With the CEM, the aim of the valuation is first to have the WTP for each of the attribute levels, and second, for the decision makers, to have the WTP of a complete public measure acting on all the non-monetary attributes by adding the WTP per attribute. The MPM is directly concerned with the public actions that combine several programmes and it verifies the presence of substitution or complementarity effects in the valuation. It corresponds to the sequential implementation of a contingent valuation of a public action comprising several programmes. As with the case of comparison of CEM results with those of standard contingent valuation (Adamowicz, Boxall, Williams and Louviere [1998]) (Foster and Mourato [2003]), the distributions of the WTP values with the CEM and with the MPM can be compared since they are the result of the formula developed by (Hanemann [1984]) using the coefficients of a discrete choice model.

1.3. The specificity of landscape policy and the problem of valuing it

Generally speaking, landscaping action takes place via a number of benchmarks called landscape attributes presenting specific characteristics and mechanisms (Cabanel [1995]). The decision to conserve or transform a particular attribute affects the aesthetic value of another attribute when these attributes are perceived jointly by the observer. This is called the *composition effect*. This composition effect may concern on the one hand the relationships between the attributes of the same landscape scene and on the other hand the relationships between the attributes of different scenes located in two distinct zones and which contribute to the diversity of the landscapes (Rambonilaza [2004]). Landscape attributes can thus be substitutable or complementary in the utility function of individuals. In this case, the sum of

WTP for each attribute is different to the WTP for an action jointly targeting all the attributes. The CEM can thus provide an under-estimation or over-estimation of the WTP, depending on the scale of the inclusion-effect.

It is therefore tempting to say that in the framework of a landscape valuation, the use of the contingent valuation method for landscape scenes can provide less biased results than those from the CEM method (Hoehn [1991]). But there is an abundance of literature on the comparison of these two methods and the results are not convergent. However, we should emphasise that in most cases, the relationships between the attributes under consideration are defined on the basis of an *a priori* on the part of the researcher and are not empirically validated. The results are therefore difficult to interpret when they diverge from expected results, notably when no significant difference is found.

In this study, we therefore successively implement the CEM and the MPM to analyse the specificities of the preferences of main-home residents for the landscape attributes of a rural region in the Regional Natural Park of Armorique (Brittany, France) and the impact of these specificities on their WTP. A comparison of the results of a CEM with, this time, a multi-programme valuation, will allow us to infer precisely the nature of the links between the attributes in the utility function of the individuals on the one hand, and in the valuation on the other hand (because of the revenue effect for the landscape). This approach sheds further light on the results obtained by the contingent valuation method and the CEM method.

2. Implementation of the choice experiments method

2.1. Choice of attributes to define the landscaping action scenarios

The Monts d'Arrée site selected for this study is characterised by two types of landscape: "agricultural" landscape in the north and "wild" landscape in the south. On this dual territory, the issues encountered in terms of landscape are of two types. The first relate to the farming area and raise, in particular, the question of the renaissance of "hedgerows " and the integration of farm buildings into the landscape. The second landscaping preoccupations concern the moorland, and raise questions notably about the means to maintain a traditional moorland landscape. Open "high" moorland is rare in ecological terms, and its maintenance is therefore one of the vocations of the Regional Natural Park of Armorique.

The selection of attributes must be guided by the desire to choose attributes which on the one hand affect the choices of individuals and on the other hand are pertinent from the point of view of public policy. Three landscape attributes are distinguished to evaluate the identified landscape issues and the landscape policies implemented, notably by the Regional Park in this area. The moorlands concern the southern part of the site, and the hedgerows and farm buildings the northern part. These choices were validated by experts and by the results of a sociological study on the landscape in this same zone (Le Floch [2000]). Each landscape attribute comprises three levels. Level (1) corresponds to the situation without public intervention, level (2) and level (3) to the situation for which public intervention will be maintained: within level (2), this intervention leads to an intermediate situation, and level (3) corresponds to the most far-reaching situation. Table 3 (in the annex) describes these different levels of attributes. Implementation of the valuation methods requires a payment vehicle which is called a "monetary attribute" for the CEM. The selected payment vehicle is an increase in council tax. Implementation of the CEM method also requires definition of levels for this cost attribute. Three levels are defined using the average council tax amounts in the municipalities concerned by the study (Table 3 in the annex).

From these attributes and their different levels, scenarios can be generated, defined as the combinations of these different levels. They are then grouped together in "choice sets" or "experiments" which are presented to the respondents who indicate the scenario they prefer in each of these experiments. Application of the choice generation procedure proposed by Zwerina et al. [1996] to our set of attributes resulted in 18 scenarios being generated. We only selected 12 possible scenarios spread over 6 sets of choices. For each set of choices, the individual is invited to decide between several scenarios, two of them indicating an evolution in the landscapes comparatively to the status quo situation (no public intervention), the cost of which is nil to the respondent.

The survey was carried out in 2003 in 14 rural communes in Brittany and concerned a total of 284 households of permanent residents in that zone.

2.2. Attribute-based choice modelling

For each choice set, the individuals' choice probability is modelled according to the random utility model. The utility from an alternative is partly observable V_{ij} and partly random (ε_{ij}); V_{ij} being a function of the levels of attributes of this alternative. Individual i will thus choose alternative j if and only if it gives him a greater utility than that associated with alternative h in the same set:

$$\begin{gathered} U_{ij} > U_{ih} \ , j \neq h; j,h{=}1{,}2{,}3 \\ (V_{ij} + \varepsilon_{ij}) > (V_{ih} + \varepsilon_{ih}) \\ (V_{ij} - V_{ih}) > (\varepsilon_{ih} - \varepsilon_{ij}) \end{gathered} \tag{1}$$

Following McFadden (1973), supposing that ε_{ij} follows a Weibull distribution, we can thus express the probability of choosing alternative j as follow: $P(\varepsilon \leq \varepsilon_{ij}) = \exp(-\exp(-\varepsilon_{ij}))$, then the following conditional logit model:

$$P_{ij} = P(U_{ij} > U_{ih}) = \exp(V_{ij}) \Big/ \sum_{h=1}^{3} \exp(V_{ih}) \tag{2}$$

The results of the estimation of this conditional logit model upon the choices of main-home residents of the Monts d'Arrée region are presented in the annex (Table 4).

To obtain the willingness to pay corresponding to a given landscape programme, we need to calculate the variation in the consumer's surplus: the difference between the value of the utility associated with the status quo situation $V_{statu\ quo}$ and the value of the utility associated with an alternative j, V_{ij}. The values of $V_{j,j\neq statu\ quo}$ and $V_{statu\ quo}$ are calculated on the basis of the results of the estimation of equation (2) by selecting the parameters of the corresponding landscape attributes and by keeping the amount of the monetary attribute at zero. This difference will be converted into a monetary value by dividing by the negative of the coefficient associated with the cost attribute. In our case, this last attribute is introduced in a quadratic form, so that the WTP equation takes the following form:

$$E(WTP_{CEM}) = -\frac{V_{statu\ quo} - V_{j,j\neq statu\ quo}}{\left(\hat{\beta}_1 + 2\hat{\beta}_2 p_{\max}\right)} \tag{3}$$

where $\hat{\beta}_1$ corresponds to the estimated parameter of the level cost and $\hat{\beta}_2$ to that of the quadratic relation. $p_{\max}$ corresponds to the minimum price amount from which the denominator becomes negative. This amount is 39.5€ and at this level the WTP will be unbounded. We therefore calculate our distribution of WTP for each scenario for a value of $p_{\max}$ equal to 40€ because they correspond to an upper bounded value of the WTP for each scenario valued in this experiment and correspond to the theoretical notion of maximum willingness to pay. However, we should emphasise that when $p_{\max} \to +\infty$, WTP becomes nil. The distributions of the WTP values corresponding to each scenario appraised using the multi-programme method are presented in Table 2 below.

3. Implementation of the multi-programme method

3.1. Survey protocol

The results of the CEM survey show that the targets of public landscaping actions that maximises utility for the residents in this zone are a medium wooded moorland, a dense hedgerows, and farm buildings integrated into the landscape. It is on this basis that the programmes presented in this new survey were built (Table 1 below). As an example, the "moorland" programme represents the moorland at its medium wooded level; the other moorland levels used in the CEM have not been proposed since. We should emphasise that the scenario combining these three levels of landscape attributes (Scenario 1) was not part of the scenarios in the CEM experimental protocol. The statu quo situation presents the landscape as it would be without public intervention: the moorlands would be invaded by forestland, the agricultural areas would have no hedges, leading to consolidation of the plots, and the farm buildings would be fully visible. Each scenario can implement one, two or three programmes. There are eight possible multi-programme scenarios.

Tableau 1 : Scenarios presented (D'après Méry et Bayer, 2005).

Programme	Sc.1	Sc.2	Sc.3	Sc.4	Sc.5	Sc.6	Sc.7	Reference
Moorland	Yes	Yes	Yes	No	Yes	No	No	No
Hedgerows	Yes	Yes	No	Yes	No	Yes	No	No
Farm buildings	Yes	No	Yes	Yes	No	No	Yes	No

Note: Sc. means scenario.

We opted for the referendum format to evaluate the individuals' willingness to pay for each of the scenarios presented. This method enables formulation of the individual's utility function in the form of random utility, as with the CEM. We took up the suggestion by Hanemann and Kanninen [1998] to choose six levels of bids in order to have, for each value, sufficient observations with a reasonable sample size. There is no difference in values for alternative scenarios comprising the same number of programmes. We decided that the increase in council tax required for a scenario with just one programme should be lower by 33% than that required for a scenario with two programmes, in turn lower by 20% than that attached to a scenario with three programmes. The distribution of the six levels of bids is then done during the survey in such a way that the proportion of responses obtained with scenarios associated with "minimum" or "maximum" type bids is lower than that obtained with "intermediate" type scenarios. During the survey, each of the three scenarios with two programmes was presented first, and the other programmes in random order.

The question to reveal values was as follows: "Suppose that several landscape programmes are financed simultaneously in order to achieve a landscape situation such as the one on the left-hand photos. Would you be prepared to pay an increase in council tax of €… for these set of programmes?"

If the response to the first programme presented is an acceptance, the valuation process continues until the end. If it is a refusal, the surveyed must give the reasons for the refusal. Two cases are possible. The refusal is either because the amount is too high or because the respondent prefers the status quo situation. In the latter case, the valuation process continues. However, the refusal may also express a protest against the valuation protocol itself. The valuation ends after asking them for the reasons for this protest. We have seven observations per individual. We estimate our choice model by using the logit model in order to keep a match with the model estimated by CEM.

The multi-programme survey was conducted in 2004 on 353 permanent resident households in the same zone. A comparison of the socio-demographic characteristics of the two samples does not show any significant difference.

3.2. Scenario-based choice modelling

Individual i has the choice between two scenarios: the one with public intervention procuring utility $U_{ki,k=1,\dots,7}$ and the *status quo* scenario procuring utility U_{0i}. This utility function depends on the characteristics of scenarios (0,1…7) including the amount of the bid proposed A_k, the individual's revenues y_i and other socioeconomic characteristics h_i. For the econometrician, U_{ki} and U_{0i} include a stochastic part because one cannot observe all the individual characteristics likely to affect these utilities: $U_{ki} = V(k, y_i - A_k, h_i) + \varepsilon_j, k = 1\,\grave{a}\,7$, et $U_{0i} = V(0, y_i, h_i) + \varepsilon_0$.

The individual will accept to pay an increase in council tax of A_k in order to benefit from a protected landscape with scenario k, if: $V(k, y_i - A_k, h_i) + \varepsilon_1 \geq V(0, y_i, h_i) + \varepsilon_0,\ k = 1\,\grave{a}\,7$. By reasoning in terms of compensatory variation, we get: $V(k, y_i - C_{ki}, h_i) + \varepsilon_{1i} = V(0, y_i, h_i) + \varepsilon_{0i}$ where C_{ki} represents the individual's willingness to pay for scenario k, with $C_{ki} = C\left(k, y, h_i, \varepsilon_{1i}, \varepsilon_{0i}\right)$. The probability of acceptance to pay for the set-up of scenario k can be written thus: $P_{k,k=1\grave{a}7} = \Pr\left\{to\ accept\ to\ pay\ for\ k\right\} = \Pr\left\{C_{ki} = C(k, y_i, h_i, \varepsilon_{1i}, \varepsilon_{0i}) \geq A_k\right\}$.

With $\eta = \varepsilon_0 - \varepsilon_1$, this expression is equivalent to the following (Hanemann [1984]):

$$P_k = \Pr\left\{to\ accept\ to\ pay\ for\ k\right\} = \Pr\left\{V(k, y_i - A_k, h_i) - V(0, y_i, h_i) \geq \eta_k\right\} \quad (4)$$

Therefore, with $V_{ki} = \alpha_k + \beta(y_i - A_k) + \gamma h_i$ et $V_{0i} = \alpha_0 + \beta y_i + \gamma h_i$, equation (4) becomes:

$$P_k = \Pr\left\{to\ accept\ to\ pay\ for\ k\right\} = F_\eta\left(\lambda_k - \beta A_k\right) \tag{5}$$

where β represents the parameter to be estimated for the requested increase in council tax and $\lambda_k = (\alpha_k - \alpha_0)$ represents the parameter associated with each of the dummy variables for the seven scenarios presented. F_η represents the distribution function of η. We suppose that η follows a Weibull distribution. In this case, our choice model is a logit one. With the type of utility function we chose, the willingness to pay of individual i and the average WTP for scenario k is written thus:

$$WTP_{ki} = -\frac{\lambda_k + \eta_{ki}}{\beta};\ E\left(WTP_k\right) = -\frac{\lambda_k}{\beta} \tag{6}$$

The results of the estimation of equation (5) in the form of a logit with random effects for individuals are given in Table 5 in the annexes. The distribution of WTP for each multi-programme scenario is presented in Table 2 below.

4. Comparison of CEM and MPM results

To get a distribution of the WTP obtained for each programme presented, the method proposed by Krinsky and Robb [1981] is used. We started by generating, for each of the regression coefficients, a normal multivariate distribution of mean, of variance and of covariance corresponding to the values obtained with the econometric estimation. The size of this distribution may be set arbitrarily but it is preferable to have quite a large size. We chose to generate 10,000 observations. Here, we use the values of the coefficients of the attributes of the utility function of each scenario j to generate the distributions of the $WTP_{CEM,k}$ from the CEM for $j = k$ using the formula given by equation (3), and the coefficients associated with each parameter of the programmes and that of the bid from the multi-programme evaluation to obtain $WTP_{MP,k}$ according to equation (6).

A comparison of the results obtained with the two approaches is made on the basis of a statistical test. Hypothesis H_0 in our test stipulates here that for each scenario considered the two methods give the same estimation of WTP: $WTP_{MPM,k} - WTP_{CEM,k} = 0$. Hypothesis H_1 stipulates that $WTP_{MPM,k} \neq WTP_{CEM,k}$. We reject H_0 when the calculated statistic is higher than the critical value of the normal distribution $N(0,1)$ at 5%. The results of these tests are given in the table 2.

Table 2 - Comparison of the distributions of the WTP from the two methods

Scenarios (cf. table 1)	WTP_{MCE}	Confidence interval (95%)	WTP_{MP}	Confidence interval (at 95%)	Decision (at 5%)
Scenario 1	133	[58,207]	113	[41,185]	Identical
Scenario 2	103	[41,165]	67	[25,108]	Identical
Scenario 3	64	[34,94]	33	[23,42]	Identical
Scenario 4	100	[43,157]	85	[53,117]	Identical
Scenario 5	33	[15,51]	47	[13,81]	Identical
Scenario 6	69	[24,113]	68	[9,128]	Identical
Scenario 7	30	[18,43]	27	[21,32]	Identical

The results of the comparison of the WTP using the two methods show that there is no significant statistical difference between the values estimated with the multi-programme method and the choice experiments method. Independently of the problems of bias associated with the estimations, and following the hypotheses forming the basis of the choice experiments method, these results mean that the landscape attributes are indeed independent from each other. There is therefore neither a substitution relation nor a complementarity relation between these attributes in valuation.

To validate this hypothesis, we reformulated the choice model for the multi-programme by estimating the probability to choose scenario according to the programmes integrated into this scenario and socioeconomic characteristics of the individuals. However, the logit estimation of this probability cannot enable us to obtain the effect of each programme on the WTP for the corresponding scenario (Santos [1998]). This is why, in order to obtain these effects, we estimated a censored logit model (Cameron [1988], [1991]) which gave us the impact of each programme and their interactions on the WTP for each scenario (WTP_{ki}). The results of this estimation (see Table 6, column 3, in the annex) show us that none of the parameters of the interaction variables is significant. The valuation of a combination of two programmes targeting several distinct landscape attributes is thus equal to the sum of their separate valuation. These very clear results lead us to conclude that for the case of the rural landscape in the Monts d'Arrée, the attributes are valued independently by the main-home residents. The results of the MPM validate those obtained with the CEM method.

Conclusion

The work presented here offers a more refined exploration of the approaches to the value of natural assets, certain components of which can be modified. Landscape policies typically correspond to the protection or conservation of certain attributes that are deemed important. As these choices generate costs, it is legitimate to attempt to identify the associated benefits. An important question needs to be answered: can the appraisals be conducted by estimating the value of pertinent attributes independently, or should the estimation be done jointly? There is no general answer to this question, but the answer is decisive in justifying use of the CEM method. And this method is unrivalled in the study of the value associated with each level of the attributes.

The dominant opinion (Louviere [1994]) is that the main effects to which the CEM method confines itself largely explain the variance of choice probability equation. However, Santos [1998] emphasises the fact that in landscape terms, there may be inter-programme inclusion effects, here meaning public action targeting a landscape attribute, even though in his study the results are not very robust throughout the different successive combinations. Indeed, he notes a substitution relation with a combination of two programmes but a complementarity relation with three programmes, in a context where the revenue effect is virtually nil. Here, we show that for the rural landscapes of Monts d'Arrée in Brittany, things are different. The strength of the demonstration lies in the use of MPM and CEM with the same population. This clearly shows that there is no significant statistical difference in the distribution of WTP between the two methods.

Our results therefore consolidate the pertinence of using the cost-benefit analysis when appraising landscape policy, for two reasons. The public policies implemented, particularly agri-environmental measures, are often made up of specific actions acting on a landscape element. Use of an evaluation by attribute therefore seems to give unbiased estimations of benefits which can be compared to the cost of each single measure. In addition, the independence of the values of landscape attributes for the rural areas studied here is good news for the use of benefit transfer in relation with the CEM (Morrison et Bennett [2000]). Indeed, if the substitution (or complementarity) effects were large, the transfer of the WTP of an estimated attribute from one landscape site to another site would be an even more difficult exercise.

Annexes

Table 3 – Different levels of attributes for CEM in Monts d'Arrée

Attributes	Levels
Moorlands	(1) Very wooded (2) Medium wooded (3) Open (maintained)
Hedgerows	(1) Disappearance of hedgerows (2) Little hedgerows (3) A lot of hedgerows
Farm buildings	(1) Not integrated into the landscape (2) Partially integrated (not very visible) (3) Well integrated (not visible)
Extra council tax (€/household/year)	(1) €15 (2) €30 (3) €45

Table 4 – Econometric equation of the choice model with the experimental choice analysis method

	Coefficient	Student's t-test
Moorland (2)	0,47***	6,56
Moorland (3)	-0.21***	-2.56
Hedgrows(2)	-0.07	-0.78
Hedgerows(3)	0.71***	5.80
Farm buildings (2)	-0.26***	-2.79
Farm buildings (3)	0.49***	4.54
Price	0.08***	4.46
Price*Price	-0.001***	-4.84
Log-likelihood		-1303
Pseudo-R²		0.30
Number of observations		5112
Number of individuals		284

Notes: ***: significant at 1%; **: significant at 5%; *: significant at 10%

Table 5 – Econometric equation of the choice of accepting to pay for scenario k in the multi-programme evaluation (logit model with individual random-effects)

Probability of acceptance to pay for scenario $k=1$	Coefficient	Student's t-test
Scenario 1	2.55***	6.13
Scenario 2	1.57***	4.08
Scenario 3	0.74**	1.99
Scenario 4	1.74***	4.49
Scenario 5	1.07***	3.85
Scenario 6	1.59***	5.59
Scenario 7	0.48*	1.76
Scenario 2 first=1	4.18***	7.33
Scenario 3 first=1	3.59***	6.63
Scenario 4 first=1	3.69***	6.48
Increase in tax	-0.02**	-2.25
Revenue<1500=1	-0.41	-1.49
Correlation coefficient $\rho=\sigma^2_u/(1+\sigma^2_u)$	0.48*	
Log-likelihood		-816.04
Number of observations		1547
Number of individuals		353

Notes: ***: significant at 1%; **: significant at 5%; *: significant at 10%

Table 6 - Econometric equation of the choice model of scenario k according to the scenario's characteristics (conditional logit model)

	Coefficient of the simple logit	Student's t-test	Coefficient of the censored logit after transformation according to Cameron (1991)	Student's t-test
Variable explained	Probability of acceptance to pay for scenario k=1		Total WTP for scenario k (in €)	
Scrubland $=1$	0.49***	3.28	48**	2,11
Hedgerows $=1$	0.84***	5.46	82**	2,14
Farm buildings $=1$	0.27*	1.69	27*	1,65
Scrubland*Hedgerows	-0.05	-0.21	-5	- 0,20
Scrubland*Farm buildings $=1$	0.10	0.44	10	0,42
Bocage*Farm buildings $=1$	0.27	1.09	26	0,95
Scrubland*bocage*Farm buildings $=1$	-0.35	-0.9	- 34	- 0,85
Farm buildings*revenue <1500€ $=1$	-0.40***	-2.67	- 38*	- 1,67
Increase in tax	-0.01**	-2.00		
Correlation coefficient $\rho=\sigma^2_u/(1+\sigma^2_u)$	0.43			
Log-likelihood		-965		
Number of observations		1547		
Number of individuals		353		353

Notes: ***: significant at 1%; **: significant at 5%; *: significant at 10%

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