The impact of water protection measures in the Vittel impluvium on recreational values: A choice experiment with local residents

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Abstract

Actions undertaken for the protection of source water catchment areas by mineral water companies also produce positive externalities. Mineral waters create value for the water companies and its consumers, but for the territory and the local population also, in particular through the environmental and social services (e.g., habitats, landscape, and recreation) jointly produced with the protection of water quality. This paper aims at assessing the environmental and social preferences of the local population of Vittel (France) and surroundings, the area where Nestlé Waters produces the natural mineral waters of VITTEL®, CONTREX® and HEPAR®. From a choice experiment (CE) method, we test different scenarios of recreation activities considering two types of recreational areas: the countryside and the forest. While most of attributes are common to both scenarios, some are also specific to the forest and others to the countryside.

Keywords: Mineral Water Company; Vittel; Water quality protection; Environmental and recreational services; Choice Experiment.

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1. Introduction

Nestlé waters is the world leader in the sector of bottled water. In France eight brands of mineral natural or spring waters are distributed by Nestlé waters (PERRIER®/PERRIER FINES BULLES®, VITTEL®, HÉPAR®, CONTREX®, S.PELLEGRINO®, NESTLÉ PURE LIFE® et ACQUA PANNA®). Among these brands, VITTEL® is probably one the most emblematic; and the brand name has always been "*strongly associated with images of health and vitality*" (Perrot-Maître 2006).

In 1988, the production unit of Vittel noticed a "*deterioration in the quality of its mineral water, a slow but notably significant increase in nitrates*". The main cause was identified as "n*onpoint source pollution from intensive farming practised in the fields surrounding the Vittel springs*" (Deprès *et al*., 2005). One of the reasons of that pollution was identified as the production of corn, which is considered as an "*important factor in nitrate increase in groundwater*" (Deffontaines and Brossier 1997; Perrot-Maître and Davis 2001).

To address this problem, several alternatives were available to Nestlé waters (see Deprès *et al*, 2005 for the details). One of these alternatives consisted in achieving contractual arrangement with farmers. After a collaboration between the National Institute of Agronomic Research (INRA), Agrivair (a subsidiary company of Nestlé Waters dedicated to this issue, and local farmers, some concrete measures were adopted to guarantee the water quality: cessation of corn culture, compost of animal waste, etc. By doing so, the Vittel case became the "*first recognized initiative*" of Payment for Environmental Services (PES) in France (Hernandez and Benoit, 2011). The originality is that the PES scheme is supported by a private actor, Nestlé Waters-Agrivair and corresponds to a situation where direct payments by service beneficiaries are made to service providers, in which both providers and beneficiaries are private entities (individuals, groups of individuals, or private companies) (Greiber, 2011). The Organization for Economic Co-operation Development (OECD, 2005) and Perrot-Maître (2010) share the same conclusion: "*in the presence of market failure, private transactions and voluntary approaches are more efficient, effective, equitable and sustainable than government approaches and need to be encouraged*" (Perrot-Maître, 2010).

According to the United Nations Economic Commission for Europe (UNECE, 2007) "*Economic analysis is an essential tool for efficient decision-making regarding the establishment of PES* *schemes. It provides a coherent framework that allows a comparison of the costs and benefits of changes in water-related ecosystem services in an integrated manner*". These benefits are larger than the water quality preservation. According to Leonardi *et al*. (2018) "*increasing attention is being paid to co-benefits of PES schemes* […]". Indeed, economic and social benefits (for example) "*increase the acceptability and effectiveness of the overall scheme*" (Leonardi *et al*., 2018). These benefits can be observed at a local or a global level, and in some cases "*a local activity has national or global implications*" (Lipper *et al*., 2009). Identifying these benefits is therefore an important issue.

For example, in the case of Vittel, according to Perrot-Maître (2010), "*the impairment of the water quality would have eventually led to the closing down the natural mineral water business in the region that would also have affected the economy",* including local farmers, employment and more global economic activity. The development of the local biodiversity is another good example of a positive externality: "[…] *successful PES schemes re-enforce the multifunctional role of ecosystems (through co-benefits) and highlight the economic and social benefit, which increase the acceptability and effectiveness of the overall scheme*". In the case of Vittel, "*measures specifically targeting biodiversity protection were also supported by Nestlé, insofar as these were functional to the realisation of the core objective of sustainable farming practices to maintain high-quality mineral drinking water*" (Dupuis and Vinuales, 2013).

In order to give a value to the environmental and social services jointly produced with the preservation of water quality, we propose to use a choice experiment (CE). This method "*generally considered as* […] appropriate […] *for the valuation of multi-attribute non-market goods*" (Tu *et al*., 2016) is based on the idea that any environmental good can be described in terms of attributes, and in terms of levels that these attributes can take (Hanley *et al*., 2001; Birol and Koundouri, 2008).

We test various scenarios of recreational activities considering diversity of landscapes (i.e., countryside and forest) and thus different recreational sites. While most of attributes are common to both scenarios, some are also specific to the forest and others to the countryside. We thus estimate the willingness to pay (WTP) for these different environmental and social attributes in order to elicit some direct use values (related to recreation) and indirect use values (related to landscape and biodiversity)[3]. Furthermore, we test the hypothesis that local attachment to the region increase the likelihood to choose the status quo option.

This paper is organised as follows: in the following section, we present our methodology by describing the literature background on recreation activities and CE, the experimental design, and the survey carried out in region of Vittel in France. In Section 3, we present the empirical application. In Section 4, we present the (preliminary) estimation results based on a sample of 80 fully completed questionnaires. Section 5 concludes the paper.

2. Methodology

2.1. Recreation activities and CE

Nonmarket valuation as based on individual choices and preferences underlying those choices is one (but not the only) way that researchers and practitioners have sought to define and measure the values that individuals assign to environmental goods and services.

Standard economic theory defines value in terms of the trade-offs that individuals are willing to make between different situations. The value of a good or a service, estimated as the variation of its quantity (or the improvement or a degradation of its quality in a case of environment and natural resources), is the maximum amount of another good that an individual would be willing to give up in exchange of an improvement of that is being valued.

The total economic value (TEV) of a good can be decomposed according to a standard classification (National Research Council 2005). That classification shows that the TEV of a natural resource or an environmental good not only includes the benefits individuals get through the (direct) use of the good but also the value they place on the good even if they do not actually use or come in contact with it (non-use and option values). In this paper, we use CE to estimate the direct and indirect use values associated with the recreational activities of the local population around the impluvium. In other terms, we use choices of recreational sites to collect information about respondents' preferences for environmental services, such as landscape and biodiversity.

[3] This present preliminary version of the paper does not include WTP estimates, as the survey is still on-going

To estimate the values linked to environmental attributes, different valuation methods are available, often classified in two categories: methods based on revealed preferences and methods based on stated preferences. The first one consists in estimating non-market values by observing actual behaviour that is linked in some way to an environmental good or attribute, while the second one consist in directly asking individuals questions related to their preferences in a survey and inferring values from their stated responses.

According to Holmes *et al.* (2017), "*there has been an explosion of interest*" in CE during the past two decades. If the method began to be applied in the early 80's (Costa and Hernandez, 2019) with the works of Louviere and Hensher (1983, 1989), and Louviere and Woodworth (1983), the paper that "*generated attention in the environmental economics community*" (Carson and Czajkowski, 2014) was the one of Adamowicz *et al*. (1994).

More recently, the Discrete Choice Experiment (DCE) technique had been used in ecosystem services valuation (see Chaikaew *et al.* 2017 for more details) or to examine the choice of farmers to adopt environmentally friendly practices (Chèze *et al.* 2018). After a literature review of stated preference studies in agriculture, environment and health, over the period 2004-2013, Mahieu *et al.* (2014) concluded: "*Our main result from a systematic review of the literature of stated preferences studies published over the last ten years is that CE is becoming more popular than contingent valuation*".

In this paper, we use the CE method, which belongs to the second category. More specifically, we implement a survey on the recreational activities of the local population to estimate the direct use value associated with recreational site attributes. We consider two types of recreational sites: the countryside and the forest. Respondents are asked to choose between two hypothetical sites, one referring to the countryside, and the other one referring to the forest and a status quo alternative which is the last visited forest. Before the choice experiment the respondent are asked to indicate if their last visits was in a forest or in the countryside and to describe the site based on the attributes considered in the CE.

2.2. Experimental design

A literature review was the first step to select the relevant attributes. Because the Vittel case is known as the first example of PES in France (Hernandez and Benoit, 2011), the scientific literature on that case is quite important (see Perrot-Maître, 2006, Chia and Raulet Croset, 1994, among others). These papers help to identify the services jointly produced by water protection measures, like the preservation of biodiversity or landscape quality. Moreover, the existing literature on CE for recreational activities gave us some inspiration to think about the levels to consider in our study (i.e: Carson *et al.* 1990, Boxall *et al*., 1996, Bateman *et al*., 2003 and Christie *et al.*, 2007).

Table 1 presents the eight attributes selected in our CE and the attribute levels. Some of the selected attributes are common to the forest and to the countryside; some others are specific either to the countryside or to the forest.

Table 1. Recreation attributes and levels

Attribute	Level
Characteristics common to forest and countryside	
Equipment (picnic tables, bins, information signs)	Presence or absence (1/0)
Marked hiking and biking trails	Presence or absence (1/0)
Water stream	Presence or absence (1/0)
Pesticides	Use or not use of pesticides (1/0)
Distance	Two-ways distance to the recreational site (eight levels: from 1 to 40 km). The greater the distance to be covered, the higher the cost.
Characteristics specific to countryside	
Hedgerows and biodiversity	level of hedgerows and associated level of biodiversity (absence, low number, high number)
Agricultural land use	Type of farming practised in the countryside (grasslands, cereal fields, livestock, or mixed).
Characteristics specific to forest	
Tree species	Forest composition in term of tree species (deciduous, coniferous, or mixed)

In order to see if the chosen attributes and levels were relevant for members of the local population, a focus group was organized, on June 3, 2019 as follows:

a) Presentation of the survey;
b) Completion of the questionnaire;
c) Answers to the questions, comments and suggestions from the respondents;

d) "*Most enhanced characteristics*" exercise: participants had to write on a paper what was the attribute they appreciate the most during a recreational outing. A quite similar question (about the five favourite characteristics this time) has been included in the survey.

The respondents were divided into two groups: one session took place during the morning, the other during the afternoon with six people in each group. Among the 12 respondents, all were local residents, six worked for Agrivair, three for Nestlé Waters, and the others were farmers or peasants. The main objective was to test the questionnaire. Doing so, we were able to make modifications (on form and substance) in order to make the questionnaire as clear and as relevant as possible. The focus group also gave us an opportunity to discuss about the chosen attributes.

Furthermore, the number of levels (as well as the number of attributes) has a direct impact on the experimental design. The choice of the number of levels for each attributes is therefore an important issue. The focus group allowed us to make some modifications about the attributes levels. For example, considering the fact that the corn culture has a negative impact on water quality, we first chose to include a corn attribute in the design. However, during the focus-group period, some respondents argued that looking only at this particular culture was too restrictive. Consequently, we decided to include other forms of agricultural land use, like the presence of livestock or grasslands.

Regarding the final numbers of levels, half of the attributes (i.e., equipment, marked hiking and biking trails, water streams, and pesticides) are binary. These attributes correspond to the presence or the absence of the attribute on the recreational site. We chose to use more levels for three attributes, considering their complexity. Two of them are specific to the countryside:

a) The attribute "*hedgerows and biodiversity*" must allow respondents to choose whether they appreciate the presence of hedgerows (and associated increased biodiversity) on a recreational site, but also the quantity they prefer: no hedgerow, low hedgerow quantity or high hedgerow quantity;

b) The attribute "*agricultural land use*" has four attributes: grasslands, cereal fields, livestock, or "*mixed agricultural plots*" which refers to a mix of the first three agricultural land uses.

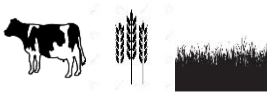
The attribute "*tree species*" is specific to the forest, and describe it composition, depending on the species we can find in the different forest sites in the Vittel region. We chose to include three different types of forests: a forest composed exclusively of deciduous trees, a forest composed exclusively of coniferous, or a mix of these species.

Finally, the distance attribute has eight levels, from one kilometre (km) to 40 km. The information collected about the distance that people accept to travel will be used to estimate the monetary value they give to the attributes by converting travel distance to travel costs.

According to Hanley *et al* (1998), "*the choice experiment approach involves the use of statistical design theory to construct choice scenarios which can yield parameter estimates that are not confounded by other factors*". Researchers use an experimental design "*to map attributes and levels into sets of alternatives to which respondents indicate their choices*" (Johnson *et al.*, 2013). The design aims at isolating the effects of individual attributes on choice (Hanley *et al.*, 1998). The experimental-design step consists in generating "*the variation in the attribute levels required to elicit a choice response. Efficient experimental designs maximize the precision of estimated choice-model parameters for a given number of choice questions*" (Johnson *et al.*, 2013). In our case, we generated 24 choice sets which were allocated to three blocks with 8 choice sets to reduce the number of choices per respondent. An efficient statistical design was estimated applying NGENE (ChoiceMetrics 2014).

Each choice set was composed of three alternatives: the status quo, based on information about the last visit made by the respondents in a forest or in the countryside during the last 12 months with a recreational goal. If no visit has been made during this period, we asked the same question for the last 5 years. If the number of visits is still zero, the respondents do not have the opportunity to answer to the CE. The two others alternatives are generated on a hypothetical basis, but with the same attributes. Table 2 shows an example of a choice set. Each attribute is illustrated with a pictogram, even in the status quo alternative. The choice of using monochrome pictograms and not photos was motivated by the desire to not influence the answers.

Table 2: Example of a choice set

Characteristics	Last visited forest or countryside scenario (status quo)	Countryside scenario	Forest scenario
Equipment			
Marked hiking and biking trails			
Water streams			
Pesticides			
Agricultural land use			
Tree species			
Hedgerows and biodiversity			
Distance	22 km	15 km	20 km
Your choice	○	○	○

2.3. Survey

This step concerns the practical implementation of the survey. The first issue sampling and the geographical targeting. Considering the fact that the aim was to survey the local population around the two municipalities Vittel and Contrexéville, a perimeter of 15 kilometres has been established. In that perimeter, municipalities (except the largest ones, i.e., Vittel, Contrexéville and Mirecourt), were randomly selected, see Fig. 1. The following step was to establish a rule to construct a 600 household's sample: we chose to survey 5% of the households in the three largest municipalities and 10% in the others (see Table 3). In total, 13 municipalities and 624 households are included in the sample.

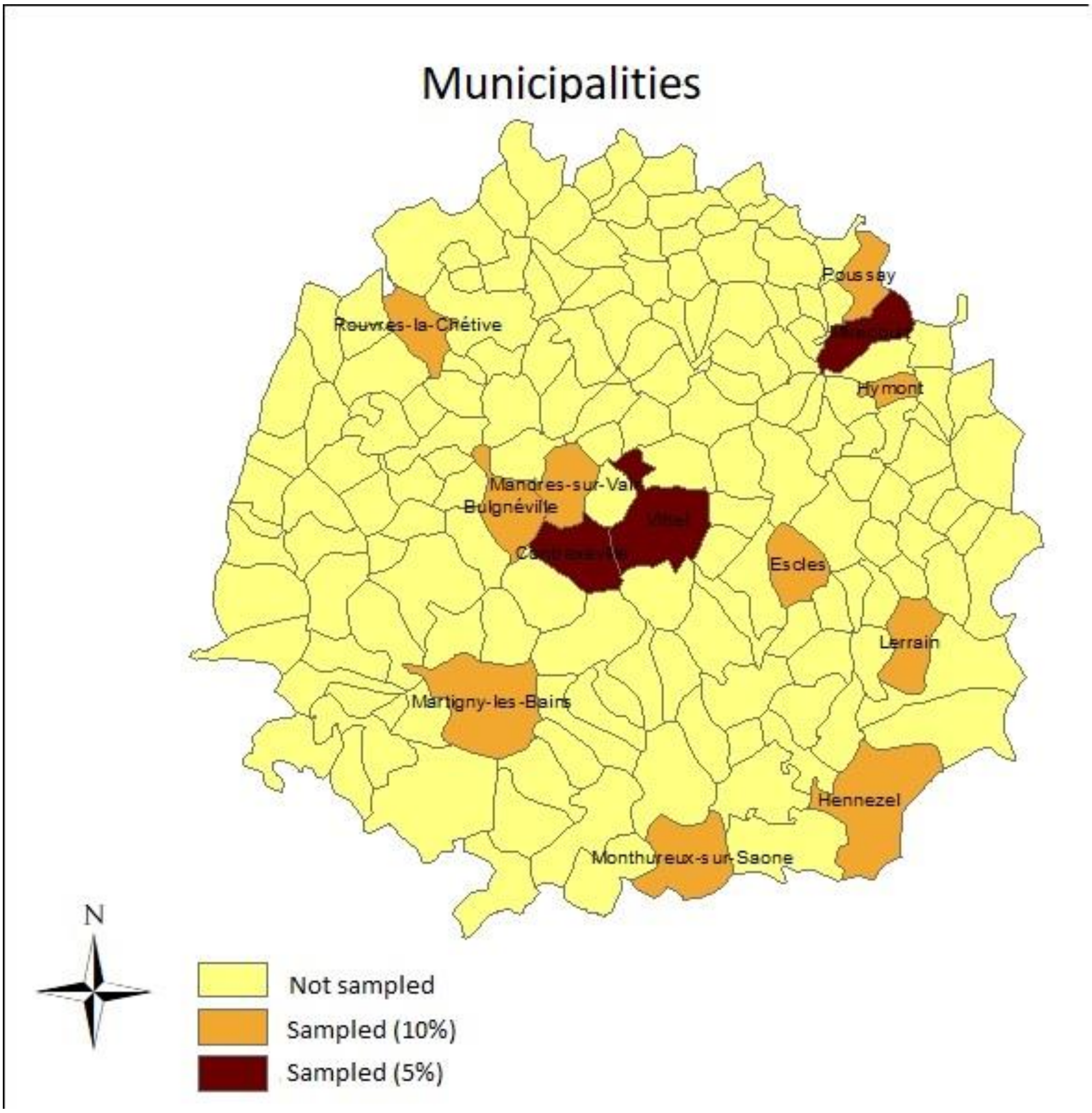


Figure 1: Map of the municipalities included in the sample

Table 3. Sample and randomly selected municipalities

Municipality	Number of inhabitants	Number of households	5% of the households	10% of the households
Mirecourt	5,285	2,561	128	
Vittel	5,192	2,702	135	
Contrexéville	3,232	1,577	79	
Monthureux-sur-Saone	862	383		38
Mandres-sur-Vair	464	162		16
Poussay	698	311		31
Rouvres-la-Chétive	452	192		19
Hymont	477	219		22
Bulgnéville	1525	624		62
Lerrain	476	206		21
Hennezel	404	188		19
Escles	435	179		18
Martigny-les-Bains	799	363		36
Total	20,201	9,667	342	624

Note. Total number of municipalities = 13.

We worked with the company Wood'up to implement the survey. As we chose to do it in face to face, two surveyors were hired to visit the respondents with tablets. This process allows them to answer potential questions and to help respondents with the tablets if necessary. To make sure that the households were randomly selected, we constructed a random protocol. Following this idea of randomization, the person allowed to answer to the questionnaire was the last adult (available) to have celebrated his or her birthday. In order to facilitate the implementation of the survey, a flyer of presentation of the survey had been distributed in the selected municipalities. Finally, feedbacks are organized on a regular basis with the surveyors to monitor the progress of the survey.

3. Empirical application

3.1. The random utility model

According to Birol and Koundouri (2008) CE has a theoretical grounding in Lancaster's characteristics theory of value (Lancaster, 1966), and an econometric basis on random utility models (RUM, Thurstone, 1927; Manski, 1977): RUM aims at modelling the choices of individuals among discrete sets of alternatives j. These models assumes that the preferences of an individual among the available alternatives can be described by a utility function.

In a given sample with N respondents, each respondent n faces T choice situations. Every choice situation has a choice set of J alternatives. The total utility for respondent n choosing alternative j in the choice set in situation t is U_{njt}. This utility depends on a component that the researcher can observe, called the deterministic part of utility attributes (V_{njt}) and a random component that the analyst cannot observe (ε_{nj}) (Horowitz et al, 1994):

$$U_{njt} = V_{njt} + \varepsilon_{njt}, \qquad (1)$$

The relative contribution of each attribute X_{knt} to the overall utility U_n can be represented by a parameter β_{kn}. As a consequence U_{njt} can be written on this way:

$$U_{njt} = \beta_n X_{njt} + \varepsilon_{njt}, \quad n = 1, \dots, N, \quad j = 1, \dots, J \quad t = 1, \dots, T \qquad (2)$$

Where β_n and X_{njt} are vectors of parameters and attribute values, respectively. The individual n chooses the alternative j that brings the highest utility.

3.2. Econometric specifications

To explain the choices of the respondents and to interpret the results different statistical models can be used: according to Train (2003), the generalised multinomial logit model, also called the conditional (multinomial) logit is the most frequently used model to explain discrete choices. This model relies on the assumption of independence of irrelevant alternatives (IIA). This assumption states that the odds of the probability of any two alternatives chosen by the respondent are independent of the presence of any other alternatives in the choice set (Hensher *et al.* 2005). Moreover, the conditional logit assumes that the utility functions across respondents are identical, which means that preferences must be homogeneous. That last strong hypothesis may appear as irrelevant, that is why some other models try to address this issue: the mixed logit model accounts for heterogeneity by allowing model parameters to vary randomly over individuals. It is generally assumed that preferences vary across respondents but not across choices of the same respondent. Hence, "*a clustered specification is applied that allows for repeated choices for each individual*" (Revelt and Train, 1998). We estimate both conditional multinomial logit model and mixed logit to test the robustness of our results.

The probability of an individual *n* to choose alternative i conditional on knowing β_n can be expressed by:

$$P_n(i|\beta_n) = \frac{\exp(\beta_n X_{ni})}{\sum_{j=1}^{J} \exp(\beta_n X_{nj})} \quad (3)$$

In the case of multiple choices for each respondent, the logit probability refers to the probability that the individual *n* makes a sequence of T choices specified as $t = \{1, \ldots, T\}$. Knowing the probability of each choice as presented by equation (3), the logit probability of the observed sequence of T choices is given by:

$$P_n(j_{n1}, \ldots, j_{nT_n}|\beta_n) = \prod_{t=1}^{T} P_n(j_{nt}|\beta_n) \quad (4)$$

where j_{nt} represents the alternative chosen by individual *n* in choice situation t. The unconditional logit probability that individual *n* makes the observed sequence of choice *j* is integrated over the distribution of β:

$$L_n(\theta) = \int P_n(j_{n1}, \ldots, j_{nT_n}|\beta_n) f(\beta_n|\theta) d\beta \quad (5)$$

In a mixed logit model, the distribution parameters θ of vector β can be specified with a continuous distribution, such as normal, lognormal or triangular. The log-likelihood is maximized using maximum simulated likelihood methods (Train, 2003). In our paper, we used the statistical software STATA MP 16 and the mixlogit package (Hole, 2007). Note that the conditional logit can be written from equation (3) by replacing β_n by β, where preferences are considered as homogenous and β is the same for all individuals. We use the clogit command of STAT, which manage fixed effects and thus well adapted to our dataset where individuals plays a sequence of T choices.

3.3. (Preliminary) descriptive statistics

The survey is still in progress, so the first results presented here are based on 80 fully completed questionnaires. We only considered fully completed questionnaires, so six questionnaires were removed from the initial database (86 questionnaires). This partial analysis gave us an idea about respondents' preferences in terms of type of recreational site (countryside or forest), favourite characteristics, etc.

Table 4 shows some statistics based on recreational visits during the last 12 months. If we look at the number of visits during the last 12 months, 16 out of 80 respondents (i.e., 20% of the sample) did not visit neither the countryside nor the forest. Interestingly, none of the respondents did only one visit (in each of both types of recreational sites). 13.75% visited only the forest, and the same proportion visited the countryside only. That means that more than half of the respondents did both (52.5%). The average number of visits either in a forest or in the countryside over the last year is 51.71, i.e. around four visits/person/month.

Table 4. Descriptive statistics based on recreational visits during the last 12 months

Visits over the last 12 months	
No visit	16 (20%)
Several visits in the forest and the countryside	42 (52.5%)
Several visits (exclusively in the forest)	11 (13.75%)
one visit in the forest	0%
Several visits (exclusively in the countryside)	11 (13.75%)
One visit in the countryside	0%
Mean number of visit (regardless of the type of site)	≈ 4 visits/person/month

Note. Total number of observations = 80.

Figure 2 summarises choices made by the respondents in the CE. The respondents had to consider eight choice sets and to choose between three alternatives (status quo, forest, or countryside) within each choice set. Removing nine additional questionnaires (from people who did not visit neither the forest nor the countryside during the last 5 years), we kept 71 observations. It means that 71 respondents made eight choices, so we have 568 observations. Out of these 568 choices, the (hypothetical) alternative “countryside” had been chosen 111 times. It represents about 19.5% of the choices versus 25.2% for the hypothetical forest. That means that the status quo is clearly the favourite option (about 55.3% of the choices).

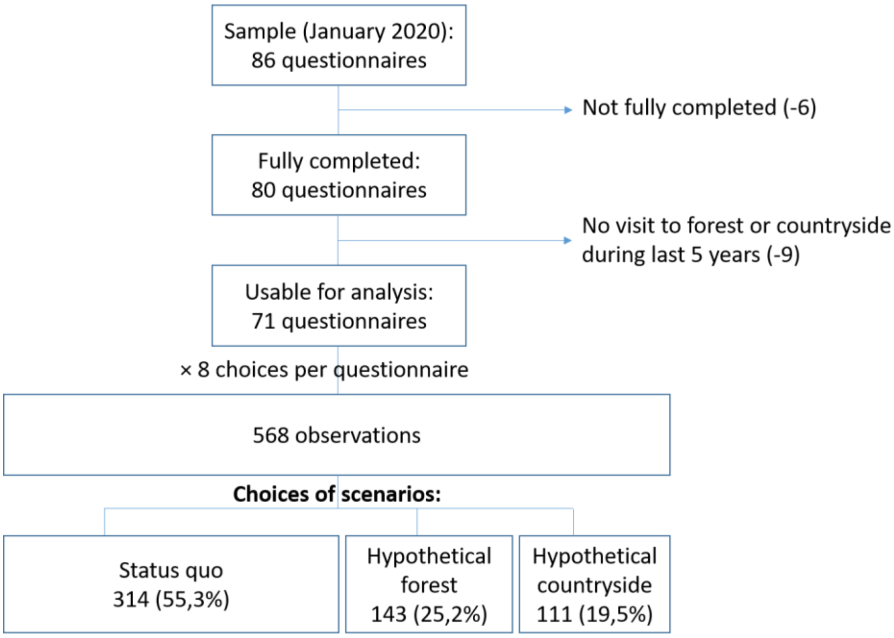


Figure 2

For each choice set, the status quo, which refers to the last forest or countryside visited during the last 12 months (or during the last 5 years if no visits had been made during the last year) is systematically the most chosen alternative whatever the hypothetical options proposed. Table 5 gives some of information about these status quos. Out of the 71 respondents, 17 always selected the status-quo (around 24%). To justify such a behaviour, nine people out of 17 argued that the status quo was always the best choice for them. Six people out of 17 pointed out the fact that the number of attributes to compare within each choice set was too important, so it required too much thought. Furthermore, 16 out of the 71 respondents (22.5%) did not consider all the attributes when choosing.

Table 5. Status quo statistics

Status quo	Number (relative frequency)
Non-systematic status quo choice	54 (76.1)
Systematic status quo choice	17 (23.9%)
Including…	
Always the best choice	9 (52.9%)
The number of attributes was too high	6 (35.3%)

Total number of respondents = 71.

A question allowed respondents to give the five characteristics of their "*ideal*" forest or countryside. Table 6 presents the most important characteristics of this "*ideal*" recreational site for both types of site. For people whose last visit was in the forest (either during the last 12 months or over the last 5 years), the most important aspect is the presence of marked hiking and biking trails: this criterion has been chosen eight times as the most important. The presence of water steams, the presence of animals and the beauty of the landscape are had been chosen 5 times each as the most important. We can notice that the beauty of the landscape is the criteria that appears most times in the five most important characteristics of the "*ideal*" forest.

Regarding the countryside, the proximity of the recreational site to the home appears 7 times as the most important criteria, the absence of pesticides 6 times (versus only 4 times for the forest). It is interesting to notice that the beauty of the landscape is the criteria that appears the most in the "*ideal characteristics*" (in both forest and countryside) but never as the most enhanced criteria in both cases.

Table 6. Most important characteristics of each type of recreational site

Most important characteristic	Number of first rank (on a five-point Likert-type scale)	Total number of appearances in the ranking
"*Ideal*" forest	Presence of marked hiking and biking trails (8)	Beauty of the landscape (33)
"*Ideal*" countryside	Proximity of the recreational site to the home (7)	Beauty of the landscape (28)

Lastly, if we focus on the last attribute, the distance made to join the recreational site and to come back is between 0.5 and 160 kilometres, with a mean distance of approximatively 16.6 kilometres. The data on the distance will be crucial to give a monetary value to the environmental and social services (using a travel cost methodology).

Finally, in Table 7 the main demographic and socio-economic characteristics are presented.

Table 7. Demographic and socio-economic statistics

Variable	Mean or proportion
Age of respondents	55
Education level	
General Certificate of Secondary Education	28.2%
High school diploma	21.1%
High school diploma + 2 years	12.7%
High school diploma + 3 years	8.5%
High school diploma + 4 years and 5 years	0%
Doctorate	1.4%
Others	25.3%
Non-respondent	2.8%

4. (Preliminary) estimation results

Based on the first responses to the CE we estimated the RUM. The estimated parameters indicate how the attributes (characteristics) of a recreational site influence the utility of visiting the site. In other words, if the estimated parameter is positive it is an attractive characteristic for an average visitor and if it is negative, the attribute has a negative impact on the utility of the visitor. The following interpretation should be considered with precaution due to the low number of choices and the preliminary nature of this analysis.

First, from Table 8 presenting estimation results of the conditional logit, we see that visitors, in general, have a higher utility of visiting the site they visited last time (status quo constant). Forests are less attractive than the countryside. We find that sites with water streams, without application of pesticides, forest with deciduous species or mixed species are preferred to coniferous and statistically significant. Several attributes were not significant which are most likely due to the low number of observations included in the analysis. For example the parameter of the distance is negative (as expected) but not significantly different from zero. The negative signs on the trails and on grassland were surprising. In particular, the negative sign on trails does not correspond to the results of the question related to the most valuable characteristics (table 6). This result may be due to an unbalanced experimental design (with respect to the distribution of responses on blocks) based on the first responses. The continuation of the survey will ensure a more balanced design and more statistical power. For this reason, we have not tried to estimate WTP based on these first results.

Table 8. Conditional multinomial logit estimation results

Variable	Estimate (Std. Error)
Last visited site (status-quo constant)	1.243***
	(0.206)
Visiting a forest relative to countryside	-0.757*
	(0.454)
Equipment relative to no equipment	-0.0277
	(0.151)
Presence of trails relative to trails	-0.489***
	(0.160)
Water streams relative to no presence of water streams	0.407***
	(0.151)
Pesticides relative to no pesticides	-0.569***
	(0.191)
Livestock relative to only cereal fields	-0.286
	(0.404)
Grasslands relative to only cereal fields	-0.806*
	(0.471)
Mixed agricultural land use relative to only cereal fields	-0.303
	(0.382)
Deciduous trees relative to coniferous forest	0.674**
	(0.325)
Mixed forest relative to coniferous forest	0.473*
	(0.271)
Weak presence of hedge rows and average level of biodiversity relative to no hedge rows and low biodiversity	0.0389 (0.303)
Presence of hedge rows and high level of biodiversity relative to no hedge rows and low biodiversity	0.505 (0.323)
Distance	-0.0106
	(0.00666)
Choices (respondents)	528 (56)
Log likelihood	-479.8
chi-squared	200.6
Prob > chi2	0.000
Pseudo R-squared	0.173

Note. *** p<0.01, ** p<0.05, * p<0.1. This table shows only the parameters of attributes – the estimated model included also dummy variables to account for individuals not knowing the characteristics of the last visited site.

The "*basic*" mixed logit model

By "*basic*", we mean that we did the estimation without including a variable that captures the fact that respondents always choose the status-quo option while they care about the area they live in. Estimation results are reported in Table 10. In this model, for the attributes which are common in forest and countryside, we included interaction term between attributes levels and the dummy variable for visiting a forest to allow for site specific preferences for these attributes. Water streams are preferred in the countryside but not significant for the forest. On the other hand pesticides have negative impact if in forest but not significant if in forest. No significant preferences for the equipment neither in the forest nor in the Countryside. We see first negative preferences for trail in the countryside while not significant for forest. Trails are preferred in forest relative to the countryside. In the countryside, the mixed agricultural plots and a high level of hedgerows is valued but not statistical significant, however, significant standard deviations. Note that we in mixed logit model (table 9 and 10) included an interaction term between the attribute, status quo, and a variable which is one if the respondent replied that they did not know the nature of attribute at the site visited the last time (variables ending with SP).

Table 9. "*Basic*" mixed logit estimation results

choice	Coef.	Std. Err.	Z	P>z	[95% Conf.	Interval]
Mean						
HaiesfaiblesSP	-4.473	1.964	-2.280	0.023	-8.324	-0.623
distcat	-0.036	0.009	-3.850	0.000	-0.054	-0.018
SentiersrandoSP	0.059	1.203	0.050	0.961	-2.299	2.417
CoursdeauSP	-0.804	1.233	-0.650	0.515	-3.221	1.614
PesticidesSP	-1.271	0.622	-2.040	0.041	-2.491	-0.051
Frtpestcds	-0.600	0.849	-0.710	0.480	-2.265	1.064
Frtstrs	1.041	0.729	1.430	0.153	-0.387	2.470
FrtCoursdeau	-1.701	0.783	-2.170	0.030	-3.236	-0.166
FrtEquipements	-0.349	0.676	-0.520	0.606	-1.674	0.976
ASCsq	1.101	0.564	1.950	0.051	-0.005	2.207
Foret	0.573	1.125	0.510	0.610	-1.632	2.779
Equipements	0.694	0.611	1.140	0.256	-0.504	1.891
Sentiersrando	-1.140	0.595	-1.920	0.055	-2.305	0.026
Coursdeau	1.746	0.619	2.820	0.005	0.533	2.958
Pesticides	-0.986	0.774	-1.280	0.202	-2.503	0.530
Elevage	-0.300	0.707	-0.420	0.672	-1.684	1.085
Prairies	-0.884	0.935	-0.950	0.345	-2.716	0.949
mixtedparcel	0.741	0.862	0.860	0.390	-0.950	2.431

Haiesfaibles	0.036	0.687	0.050	0.959	-1.311	1.382
Haiesfortes	0.231	0.969	0.240	0.811	-1.667	2.130
Feuillus	0.138	0.682	0.200	0.840	-1.198	1.473
mxtessence	0.904	0.432	2.090	0.037	0.056	1.751
SD						
ASCsq	1.683	0.333	5.050	0.000	1.029	2.336
Foret	0.676	0.241	2.800	0.005	0.203	1.148
Equipements	-1.138	0.318	-3.580	0.000	-1.761	-0.514
Sentiersrando	-0.306	0.388	-0.790	0.430	-1.066	0.454
Coursdeau	1.679	0.334	5.030	0.000	1.025	2.334
Pesticides	1.676	0.367	4.560	0.000	0.956	2.395
Elevage	1.163	0.531	2.190	0.029	0.121	2.204
Prairies	0.401	0.665	0.600	0.546	-0.901	1.704
mixtedparcel	1.452	0.452	3.220	0.001	0.567	2.337
Haiesfaibles	1.441	0.365	3.950	0.000	0.725	2.156
Haiesfortes	1.631	0.556	2.930	0.003	0.541	2.721
Feuillus	-1.453	0.554	-2.620	0.009	-2.540	-0.367
mxtessence	0.472	0.381	1.240	0.215	-0.275	1.219

Number of observations = 1,536

LR chi2(13) = 137.73

Log likelihood = -425.79478   Prob > chi2 = 0.0000

The mixed logit model with attachment

We then estimated the same mixed logit model, testing the hypothesis that a high level of place attachment may encourage respondents to choose the status-quo option. Estimation results are reported in Table 10. However, we see that the variable "*attachementASCsq*" is not significant, so we cannot conclude that place attachment has an effect on the systematic choice of the status-quo option. Looking at the coefficients of the parameters, we observe a relative stability between the estimation where we considered place attachment and the first estimation. It means that the model is quite stable.

Table 10. Mixed logit model with attachement

Choice	Coef.	Std. Err.	z	P>z	[95% Conf	Interval]
Mean						
HaiesfaiblesSP	4.172	2.299	-1.810	0.070	-8.677	0.334
distcat	0.021	0.011	-2.010	0.044	-0.042	-0.001
SentiersrandoSP	-0.189	1.677	-0.110	0.910	-3.476	3.099
CoursdeauSP	-0.720	1.242	-0.580	0.562	-3.154	1.714
PesticidesSP	-1.252	0.592	-2.120	0.034	-2.412	-0.092
Frtpestcds	-0.911	0.892	-1.020	0.307	-2.658	0.837
Frtstrs	1.295	0.727	1.780	0.075	-0.129	2.720
FrtCoursdeau	-1.891	0.774	-2.450	0.014	-3.407	-0.375
FrtEquipements	-0.730	0.715	-1.020	0.307	-2.131	0.671
attchmtASCsq	0.437	0.697	0.630	0.530	-0.928	1.803
ASCsq	1.077	0.565	1.910	0.056	-0.029	2.184
Foret	0.542	1.137	0.480	0.634	-1.686	2.769
Equipements	0.902	0.635	1.420	0.155	-0.342	2.146
Sentiersrando	-1.487	0.610	-2.440	0.015	-2.683	-0.291
Coursdeau	1.860	0.633	2.940	0.003	0.620	3.100
Pesticides	-0.754	0.793	-0.950	0.341	-2.308	0.799
Elevage	-0.605	0.764	-0.790	0.428	-2.102	0.891
Prairies	-1.169	0.977	-1.200	0.232	-3.084	0.747
mixtedparcel	0.720	0.927	0.780	0.438	-1.098	2.537
Haiesfaibles	0.014	0.699	0.020	0.984	-1.356	1.384
Haiesfortes	-0.106	1.027	-0.100	0.917	-2.120	1.907
Feuillus	0.419	0.663	0.630	0.527	-0.881	1.719
mxtessence	0.957	0.423	2.260	0.024	0.128	1.786
SD						
ASCsq	1.593	0.365	4.370	0.000	0.879	2.308
Forest	0.702	0.240	2.930	0.003	0.233	1.172
Equipements	-1.177	0.339	-3.470	0.001	-1.841	-0.513
Sentiersrando	-0.300	0.381	-0.790	0.431	-1.047	0.446
Coursdeau	1.615	0.332	4.870	0.000	0.964	2.265
Pesticides	1.623	0.361	4.500	0.000	0.916	2.330
Elevage	1.196	0.518	2.310	0.021	0.181	2.211

Prairies	0.497	0.623	0.800	0.426	-0.725	1.718
mixtedparcel	1.466	0.451	3.250	0.001	0.582	2.350
Haiesfaibles	1.349	0.353	3.820	0.000	0.657	2.040
Haiesfortes	1.660	0.544	3.050	0.002	0.595	2.726
Feuillus	-1.425	0.490	-2.910	0.004	-2.386	-0.464
mxtessence	0.380	0.383	0.990	0.321	-0.370	1.131

Number of observations = 1,536

LR chi2(13) = 136.02

Log likelihood = -426.62418 Prob > chi2= 0.000

5. Conclusion

This paper aimed at providing the first results of a CE used to evaluate the environmental and social preferences of the local population of Vittel (France) and surroundings. We detailed the construction process of the CE based on the recreational activities practiced by the residents (sport, landscape observation etc.) when they go to the forest or in the countryside. Focusing on these activities, is a way to capture the direct use values potentially modified by the environmental friendly practices implemented on the impluvium of Vittel (non-use of pesticides, hedgerows plantation etc.). The preliminary results show that, among the hypothetical scenarios, the "forest scenario" is the most chosen. Concerning the number of visits during the last 12 months, more than half of the respondents did several visits in the forest and the countryside. The mean number of visits, regardless the type of recreational area, is about 4 visits/person/month. The presence of marked hiking and biking trails and the beauty of the landscape seem to be particularly appreciated by the respondents whose last visit was in the forest. Interestingly, the beauty of the landscape is also important for people whose last visit was in the countryside, like the proximity of the site to their home. The estimation of the mixed logit model shows that the forest is preferred over the countryside and give an insight of the favourite attributes of the respondents.

References

Adamowicz W.L., Louviere J.J., and M. Williams. (1994), Combining revealed and stated preference methods for valuing environmental amenities, Journal of Environmental Economics and Management, 26, 271-292.

Bateman I.J., Carson R.T., Day B., Hanemann W.M., Hanley N., Hett T., Jones-Lee M., Loomes G., Mourato S., Ozdemiroglu E., Pearce D.W., Sugden R.,and S. Swanson. (2003), Guidelines for the Use of Stated Preference Techniques for the Valuation of Preferences for Non-market Goods, Edward Elgar, Cheltenham

Birol E., Koundouri, P. (Eds.) (2008), Choice Experiments Informing Environmental Policy: A European Perspective, Cheltenham.

Boxall, P., W. Adamowicz, J. Swait, M. Williams and J. Louviere. (1996), A Comparison of Stated Preference Methods for Environmental Valuation, Ecological Economics 18, 243–253.

Carson R.T., Hanemann, W.M., and D. Steinberg. (1990), A discrete choice contingent valuation estimate of the value of Kenai king salmon, Journal of Behavioral Economics, 19, pp 53-68.

Carson R.T., and M. Czajkowski. (2014), The Discrete Choice Experiment Approach to Environmental Contingent Valuation, in Hess S., and A. Daly (ed.), Handbook of Choice Modelling, chapter 9, pages 202-235, Edward Elgar Publishing.

Chaikaew P., Hodges A.W., and S. Grunwald. (2017), Estimating the value of ecosystem services in a mixed-use watershed: a choice experiment approach, Ecosystem services, 23, pp 228-237.

Chèze B., David M., and V. Martinet. (2018), Farmers' motivations to reduce their use of pesticides: a choice experiment analysis in France, 4ème Conférence annuelle de la FAERE, French Association of Environmental and Resource Economists.

Chia E., and N. Raulet Croset. (1994), Agriculture et qualité de l'eau : négociation et rôle de la recherche : Le cas du programme AGREV. Études et Recherches sur les Systèmes Agraires et le Développement, INRA Editions, pp.177-193.

ChoiceMetrics, (2014). Ngene 1.1.2 User Manual & Reference Giude.

Christie M., Hanley N., and S. Hynes. (2007), Valuing enhancements to forest recreation using choice experiments and contingent behaviour methods, Journal of forest economics, volume 13, issues 2-3, pp 75-102.

Costa P.D., and D Hernandez. (2019), The Economic Value of Ecosystem Conservation: A Discrete Choice Experiment at the Taravo River Basin in Corsica

Deffontaines J. P., and J. Brossier. (1997), Agriculture et qualité de l'eau: l'exemple de Vittel. Les Dossiers de l'environnement de l'Inra, 14, Paris: INRA Editions.

Deprés C., Grolleau G., and N. Mzoughi. (2005), Contracting for Environmental Property Rights: The case of Vittel, Economica, *75* (299), pp.412-434.

Dupuis P-M., and J.E Vinuales (2013), Harnessing foreign investment to promote environmental protection : incentives and safeguards, 493p.

Greiber T. (2011) Enabling conditions and complementary legislative tools for PES, in Payment for ecosystem services and food security, Food and Agriculture Organization of the United Nations, pp. 205-225.

Hanley N., Wright R., and V. Adamowicz. (1998), Using Choice Experiments to Value the Environment : design issues, current experience and future prospects. Environmental and Resource Economics 11(3–4): 413–428.

Hanley N., Mourato, S. and R. Wright. (2001), Choice Modeling Approaches: A Superior Alternative for Environmental Valuation? Journal of Economic Surveys 15(3): 435–462.

Hensher D. A., Rose, J., and W. H., Greene. (2005), Applied choice analysis. A primer. Cambridge: Cambridge University Press.

Hernandez S., and M. Benoit (2011), Gestion durable de la ressource en eau : l'utilisation du paiement pour service environnemental au service de la protection des captages, Responsabilité et environnement n° 63, pp.87-95.

Hole A.R. (2007). Fitting mixed logit models by using maximum simulated likelihood. Stata Journal 7:388-401.

Holmes T.P., Adamowicz W.L., and F. Carlsson (2017), Choice Experiments, in Champ P.A., K.J., Boyle and Brown T.C. (eds). A Primer on Nonmarket Evaluation, second edition, Dordrecht: Kluwer Academic Publishers.

Horowitz J., Keane M., Bolduc D., Divakar S., Geweke J., and Gonul F., Hajivassiliou V., Koppelman, F., and Matzkin R., and Rossi P., and P. Ruud. (1994) Advances in Random Utility Models, Marketing Letters 5:4, pp.311-322.

Johnson F.R., Lancsar E., Marshall D., Vikram K., Mühlbacher A., Regier D.A., Bresnahan B.W., Kanninen B., and J. F.P., Bridges. (2013), Constructing experimental designs for discrete-choice experiments: report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. Value Health; 16, pp.3–13.

Lancaster K. (1966), A new approach to consumer theory, Journal of Political Economics 74, pp.217–231.

Leonardi A., Masiero M., and L. Meyer. (2018), Forests and Water. Valuation and payments for forest ecosystem services, United Nation publication, 97p.

Lipper L., Sakuyama, T., Stringer, R., and D. Zilberman (Eds.). (2009), Payment for environmental services in agricultural landscapes : economic policies and poverty reduction in developing countries, 284p.

Louviere J.J., and D. Hensher. (1983), Using Discrete Choice Models with Experimental Design Data to Forecast Consumer Demand for a Unique Cultural Event. J Consum Res, 10, pp.348–361.

Louviere J.J., and G. Woodworth. (1983), Design and Analysis of Simulated Consumer Choice or Allocation Experiments: An Approach Based on Aggregate Data. J Market Re, 20, pp.350–367.

Louviere J.J., and D. Hensher. (1989), On the Design and Analysis of Simulated Choice or Allocation Experiments in Travel Choice Modelling. Transport Res Rec, 890, pp. 11–17.

Mahieu P-A., Andersson H., Beaumais O., Crastes R., F-C Wolff. (2014), Is choice experiment becoming more popular than contingent valuation? A systematic review in agriculture, environment and health. FAERE Working Paper, 12.

Manski J. (1977), The Structure of Random Utility Models, Theory and Decision, Vol. 8, pp. 229-254.

OECD (2005), Multifunctionality in Agriculture: What Roles for Private Initiatives? Paris.

Perrot-Maître D, 2010, Protecting Environmental Services in Vittel, France: A Business Opportunity for the Private Sector, Mountain Forum Bulletin, Vol. 10, Issue 1, pp. 58-60.

Perrot-Maître, D., and P Davis. (2001), Case Studies of Markets and Innovative Financial Mechanisms for Water Services from Forests. Washington: Forest Trends.

Perrot-Maître, D. (2006), The Vittel payments for ecosystem services: a "perfect" PES case? International Institute for Environment and Development, London, UK.

Revelt D., and K Train. (1998), Mixed logit with repeated choices: Households choices of appliance efficiency level, Review of Economics and Statistics, 80, pp.647–657.

Thurstone L. (1927), A Law of Comparative Judgement, Psychological Review, Vol. 4, pp. 273-286.

Train, K. 2003. Discrete Choice Methods with Simulation. Cambridge: Cambridge University Press.

Tu G., Abildtrup J., Garcia S. (2016), Preferences for urban green spaces and peri-urban forests: An analysis of stated residential choices. Landscape and Urban Planning, Elsevier, 148, pp.120-131.

UNECE (2007), Recommendations on payments for ecosystem services in integrated water resources management, 51p.