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Role of information in the valuation of unfamiliar goods—the case of genetic resources in agriculture

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Abstract: The paper uses data from a discrete choice experiment to examine information effects on stated preferences for an unfamiliar environmental good, i.e. agricultural genetic resources. We define two groups of respondents based on their use of additional information provided in an internet survey, and model information use and its effect on individual preferences and scale using the logit and mixed logit models. Our findings indicate that both sociodemographic and attitudinal variables affect the use of information, with the respondent's age, gender, familiarity and perceptions of stakeholder responsibilities having a significant effect. The results show individual preference heterogeneity, but no significant differences in scale between the information groups after allowing the mean coefficients for the attributes to differ. Those who have used the additional information derive higher utility from the changes in the protection of agricultural genetic resources. Our results highlight the importance of genetic resource conservation and controlling for the effects of information use in choice experiment models for unfamiliar goods.

Keywords: Agricultural genetic resources; Discrete choice experiments; Environmental valuation; Information effects

JEL codes: Q51, Q57

1. Introduction

Stated preference methods, such as contingent valuation (CV) and discrete choice experiments (CE), are often used for eliciting citizens' willingness to pay (WTP) for environmental goods, to provide policy-relevant information on environmental values. Nowadays, applications are common for both, goods that people are familiar with and have some experience of, such as water quality (e.g. Hanley et al., 2006; Ahtiainen et al., 2015), and goods that people may be unfamiliar with or have no practical experience of, such as biodiversity (e.g., Christie and Gibbons 2011; Jobstvogt et al., 2014). In stated preference valuation surveys, respondents are assumed to make informed choices when responding to the value elicitation questions (e.g., Blomquist and Whitehead, 1998). In order to obtain informed choices and to produce valid estimates of environmental values (WTP), surveys need to provide neutral and sufficient information about the environmental good while avoiding information overload. Hence, both the amount and type of information provided to respondents are important design features of surveys (Johnston et al., 2017).

Providing more information about the quality (characteristics and services) of the environmental good can have various effects: it can increase, have no impact or decrease the WTP (Blomquist and Whitehead, 1998). It has been argued that the provision of relevant information improves respondents' understanding of environmental commodities and reduces both uncertainty and possible divergence between the true and stated WTP (Hoehn and Randall, 1987). However, increased information in stated preference surveys increases the burden of information processing and the cognitive complexity of the choice process. Increased complexity, in turn, affects the consistency of respondents' choices and thereby their stated WTP (Berrens et al., 2004). When faced with difficult choice questions, respondents often tend to use heuristics. Sandorf et al. (2017) suggest that providing information about the environmental good in question before a CE is important because the more respondents know about the environmental good in question, the less likely they are to use simplifying strategies, such as the attribute non-attendance. As increasing knowledge helps to avoid, at least to some extent, the use of heuristics, providing information may lead to more precise welfare estimates.

In addition to the extent of the information, the nature of the information also plays a role. According to Hu et al. (2009), studies assessing the impact of information on consumers' choices have concluded that positive information tends to reduce adverse reactions, and negative information tends to reinforce negative responses. Environmental commodities can have beneficial attributes, but also attributes that can be perceived negatively. Hence, additional information describing these negative attributes can induce reductions in WTP (Bergstrom et al., 1990).

Information tends to be regarded as crucial to an individual's decision-making in situations where there is much uncertainty involved, for example, in the valuation of unfamiliar goods. It is often assumed that once the information is provided, respondents will access and process it. However, simply making information available does not mean that all the respondents will read it. Respondents' choice to access voluntary information is reliant on their previous knowledge of the topic and personal characteristics (Hu et al., 2009). Furthermore, even in the best-case scenario, it is not possible to control whether the respondents truly comprehend the information provided.

The CV literature contains a plethora of studies on information effects and their reasons, as well as on respondents' cognitive effort (see, e.g., Cameron and Englin 1997; Blomquist and Whitehead, 1998; Munro and Hanley, 2002; Berrens et al., 2004). Most of these CV studies find significant information effects on preferences and values. However, only a few CE studies have examined the use of information. Hu et al. (2009) and Vista et al. (2009) focused on respondent effort, indicated by choice to access optional information made available in the survey and the time spent on completing the survey. Hu et al. (2009) used data from a CE for genetically modified food to simultaneously model voluntary information access and product choices and demonstrated that additional information was accessed rather infrequently, and those who held critical views on genetic modification accessed the information more often. There were interlinkages between information access and choices, but they were complex and varied between individuals. Vista et al. (2009) examined the effect of time spent on attribute information, choice questions and completing the survey on preferences, finding no significant effects on parameter estimates. In turn, Curtin and Papworth (2018) sought to explore whether additional information can shift stated conservation preferences, concluding that the amount of information provided in CE affected the conservation decisions. Emberger-Klein and Menrad (2018) studied the effect of information provision on consumers' use of carbon labels. Providing additional information about the labels encouraged the use of and preference by consumers for carbon labels and could also affect the purchase decision.

Heterogeneity of preferences and heterogeneity in scale across individuals has become an important consideration in modeling CE responses (Louviere et al., 2002; Louviere, 2006; Fiebig et al., 2010; Hensher et al., 2012). Related to agricultural genetic resources, Pallante et al. (2016) and Zander et al. (2013), for example, examined both preference and scale heterogeneity. In the context of unfamiliar goods, it may be especially important to allow for scale heterogeneity, in addition to individual preference heterogeneity (Christie and Gibbons, 2011). Scale represents the variation in the random component of utility relative to the deterministic component, and scale heterogeneity implies that the scale of the error term varies across respondents. From the analyst's perspective, a higher mean scale infers that the respondents' choice behavior appears less random. Recent CE studies have investigated information effects and the familiarity of the environmental good while allowing for scale heterogeneity. Using CE data from a biodiversity conservation program, Czajkowski et al. (2016) revealed that the individual-specific preferences and the mean of scale parameter and its variance in the sample are sensitive to the information given to the respondents. Christie and Gibbons (2011) interpreted scale heterogeneity as respondents' ability to choose and concluded that accounting for scale heterogeneity can improve the reliability of the results when valuing unfamiliar or complex goods.

In this study, we contribute to the stated preference literature on the effect of information use and respondent effort on respondents' choices and WTP for an unfamiliar good. Our CE survey offered the respondents an opportunity to access additional information on the environmental good being valued, similar to Hu et al. (2009). We examine the determinants of voluntary information acquisition, and the effect of accessing the information on respondents' preferences and scale, allowing for individual preference and scale heterogeneity. The data come from a CE survey on agricultural genetic resources, which includes all animal and plant species and varieties of interest in agriculture. Although the public is likely to be aware of agricultural production and its impacts on the environment, specific aspects, such as the conservation of genetic resources, are likely to be unfamiliar to at least some of the respondents. This setting provides an excellent prospect for studying the influence of information on preferences for unfamiliar environmental goods in a CE (Pouta et al., 2014).

The paper is organized as follows: Section 2 discusses genetic resource conservation in Finland and introduces the survey and data. Section 3 presents the statistical approach. Section 4 displays the results, and Section 5 discusses and concludes the analysis.

2. Survey and data

2.1. Conservation of agricultural genetic resources in Finland

The intensification of agriculture has led to major changes in the utilization of agricultural genetic resources. Consequently, many previously-common animal breeds and crop varieties are currently on the verge of extinction worldwide. In Finland, the majority of indigenous crop varieties, as well as the Finnish landrace pig are already extinct. Furthermore, several native breeds, such as Eastern and Northern Finncattle, the Kainuu Grey sheep and the Åland sheep, are endangered, according to the FAO classification (FAO, 2007). Conservation policies for agricultural genetic resources in Finland, as in many European countries, are based on international agreements, such as the Convention on Biological Diversity (1992) and, also, the Global Plan of Action for Animal Genetic Resources (FAO, 2007). National programs to strengthen the conservation of genetic resources in Finland were initiated in 2003 for plants, and 2005 for farm animals. There has been some progress in actioning the conservation programs, but they have not been implemented fully, due to a lack of resources and political interest in conservation. Besides, there is no existing information on the economic benefits of such programs. Thus, the present study estimates the value of citizen's use and non-use benefits from the conservation of agricultural genetic resources, for policy-making support, and examines information effects in the context of valuing unfamiliar goods.

2.2. Data collection

The CE survey data were collected using a probability-based Internet panel during the summer of 2011. The Internet panel of a private survey company, Taloustutkimus, included 30 000 respondents who have been recruited to the panel using random sampling to represent the population (Taloustutkimus, 2013). Beforehand, survey questions were tested with a pilot study of 138 respondents. The final data set consisted of 1860 responses, with a response rate of 30%. Based on the sociodemographic information (Table 1) in comparison with the statistics for the general Finnish population, the data were an adequate representation of the population. Respondents were somewhat older, had lower income and were less likely to have children compared with the population.

2.3. Survey design

The survey had five sections, with general questions on environmental issues in agriculture, familiarity with and attitudes toward agricultural genetic resources, environmental values (the CE) and, finally, the respondent's background. The survey began with a short description of the most common Finnish agricultural genetic resources (native animal breeds and plant varieties), for which, the respondents were asked to indicate their familiarity. Next, the conservation of agricultural genetic resources in Finland was briefly highlighted, and the respondents were then presented with two internet links that allowed access to additional information of animal and plant genetic resources, respectively. This voluntary additional information included motivation for conservation, descriptions of conservation methods and facts about the sustainable use of genetic resources. We recorded the time respondents used to read this additional information. The provision of voluntary information enabled identifying respondents who accessed the links and documenting how much time they spent on these information pages. This approach was similar to Hu et al. (2009), who provided voluntary access to additional information. In our case, however, the choice tasks and information acquisition were not simultaneous, but, rather, the information was provided before the CE. The information page with the links was followed by questions about the perceived importance of animal and plant genetic resources. The survey then presented the current state of conservation (the status quo) and proceeded to the CE.

The CE was framed by explaining that the conservation of Finnish native animal breeds and plant varieties is not yet comprehensive. The respondents were presented with a program that would increase the conservation of breeds and varieties on farms (*in situ*) and in gene banks (*ex situ*). The conservation program was described with five attributes, each containing three levels, with first level always presenting the status quo level (Table 2). To ease the cognitive burden of the respondents, instead of having separate attributes for each animal breed, there was only one attribute for native breeds in the gene bank, and one attribute for native breeds on farms. Still, individual animal breeds were treated as separate attributes in the analyses. The cost attribute was specified as an increase in income tax over a 10-year period (2012–2021).

In the CE, the respondents faced six choice sets (see Table 3 for an example), each containing two policy alternatives and the status quo. After each choice set, the respondents were asked to rate the certainty of their choice on a scale ranging from 1 to 10 (1 = completely uncertain; 10 = completely certain).

In the experimental design, we employed a Bayesian D-efficient design using the Ngene software (v. 1.0.2) (ChoiceMetrics, 2010). Efficient designs aim to generate parameter estimates with minimal standard error values, thereby producing the maximum information from each choice situation (see, e.g., Rose and Bliemer, 2009). To generate efficient designs, it is necessary to specify priors for the parameter estimates. We employed zero priors in the pilot design and used the parameter estimates obtained from the pilot in the construction of the final design. The final design consisted of 180 choice tasks blocked into 30 subsets, which resulted in six choice situations for each respondent. See Pouta et al. (2014) for a more detailed description of the experimental design.

3. Statistical models

In the statistical modeling, we examined the use of information and its effects on scale, preferences and WTP. First, a logistic regression model (e.g., Greene, 2007) was estimated to examine the use of information. The dependent variable in the logit model was a binary variable describing information use, defined according to the time the respondent spent on the additional information pages for the native animal breeds and plant varieties. In addition to sociodemographic variables, independent variables included the perceived responsibilities for the conservation of agricultural genetic resources, the respondent's familiarity with native breeds and varieties, and the perceived importance of preserving native breeds and varieties relative to other environmental protection measures. Since only a small proportion of respondents read only one of the two information pages, we combined animal and plant information into one variable. The respondents were considered to have perused the information if they had spent 30 s or more on either of the information pages. For a fast reader, it took approximately 30 s to read each information page, so we set this as the cut-off. Table 4 presents the descriptive statistics for the variables included in the logit model.

Second, respondents' utility function parameters were modeled using the stated choices they made in the CE component of the survey. We utilized the mixed logit (MXL) model (McFadden and Train, 2000; Hensher and Greene, 2003), which allows for incorporation of unobserved preference and scale heterogeneity (Hess and Train, 2017). Following Czajkowski et al. (2014), we controlled for scale or preference differences between respondents who did/did not access additional information while modeling their choices jointly.

Formally, the discrete choice data was modeled using the random utility theory (McFadden, 1974). It assumes that the utility an individual receives from a chosen alternative depends on their observed characteristics (attributes) and unobserved idiosyncrasies, which are represented by a stochastic component. An individual i's utility from selecting alternative j in situation t can be expressed as:

$$V_{ijt} = X_{ijt}\beta_i + e_{ijt}. \quad (1)$$

The utility expression is separable in the observed choice attributes X_{ijt}, and e_{ijt} being the stochastic component allowing for unobservable factors that affect individuals' choices. The parameters β_i represent individual-specific taste parameters associated with marginal utilities of the choice attributes, allowing for heterogeneous preferences among the respondents. The multivariate (parametric) distribution of these parameters in the sample is $\beta_i = f(b, \sum)$, where b is a vector of sample means and $\sum$ is a variance-covariance matrix. A convenient way of accounting for preference differences associated with accessing information is $\beta_i = f(b + z_i\delta, \sum)$, where z is a binary indicator for accessing information, and δ is a vector of its estimated attribute-specific effects.[1]

The stochastic component of the utility function ($\boldsymbol{e_{ijt}}$) has an unknown, possibly heteroskedastic variance $\left(var\left(e_{ijt}\right) = s_i^2\right)$. The model is usually identified by normalizing this variance, making the error term $\varepsilon_{ijt} = e_{ijt} \cdot \frac{\pi}{\sqrt{6s_i}}$ identically and independently, extreme value type-1 distributed with a constant variance $var\left(\varepsilon_{ijt}\right) = \pi^2/6$, leading to the following specification:

$$U_{ijt} = \sigma_i X_{ijt}\beta_i + \varepsilon_{ijt}, \quad (2)$$

where $\sigma_i = \frac{\pi}{\sqrt{6s_i}}$ is the 'scale' parameter. Due to the ordinal nature of utility, this specification still represents the same preferences for individual i. Note that since the scale and preference parameters enter the model as multiplication, they are not separately identifiable. However, this does not restrict model applicability, because utility function parameters do not have an absolute scale and can only be interpreted in relation to zero and each other.

Accessing information is likely to influence the variance of the stochastic component of the utility function (scale), that is, the level of randomness of choices from the modeler's perspective. As a result, since the variance of the error term is normalized in the model, parameter estimates of all the utility function parameters would increase or decrease relative to those who have not accessed information and whose scale is used as a baseline. A convenient

[1] The specific distributions (f) must be assumed by the modeler; it is typically done based on model fit.

way of controlling for scale differences associated with accessing information is $\sigma_i = \sigma\big(exp(\lambda z_i)\big)$, where z is a binary indicator for accessing information, and λ is a parameter capturing its effect for scale, relative to the baseline group of individuals (e.g., Czajkowski et al., 2015; Ruokamo et al., 2016).

Finally, given that we are interested in the marginal rates of substitution with respect to the monetary attribute p, it is convenient to introduce the following modification, which is equivalent to using a money-metric utility function (also called estimating the parameters in WTP space; Train and Weeks, 2005):

$$U_{njt} = \alpha\big(p_{njt} + Y_{njt}b\big) + e_{njt} = \alpha\big(p_{njt} + Y_{njt}\beta\big) + e_{njt}. \quad (3)$$

In this specification, the vector of parameters $\beta = b/\alpha$ can be directly interpreted as a vector of implicit prices (marginal WTPs) for the non-monetary attributes Y_{njt}, facilitating interpretation of the results.

The model is estimated using maximum likelihood techniques. An individual will choose alternative j if $U_{ijt} > U_{ikt}$, for all $k \neq j$, and the probability (P) that alternative j is chosen from a set of J alternatives is given by:

$$P(j|\,J) = \frac{exp(\sigma_i X_{ijt}\beta_i)}{\sum_{k=1}^{J} exp(\sigma_i X_{ikt}\beta_i)}\,. \quad (4)$$

There exists no closed form expression of Eq. (4), but it can be simulated by averaging over D draws from the assumed distributions (Revelt and Train, 1998). As a result, the simulated log-likelihood function becomes:

$$\log L = \sum_{i=1}^{N} \log \frac{1}{D} \sum_{d=1}^{D} \prod_{t=1}^{T_i} \sum_{k=1}^{J} y_{ikt} \frac{\exp\big(\sigma_i \mathbf{X}_{ijt} \boldsymbol{\beta}_i\big)}{\sum_{k=1}^{J} \exp\big(\sigma_i \mathbf{X}_{ikt} \boldsymbol{\beta}_i\big)}, \quad (5)$$

where y_{ikt} is a dummy taking the value of 1 if the alternative k is chosen in the choice situation t, and zero, otherwise. Maximizing the log-likelihood function, Eq. (5), gives estimates for the parameters.[2]

[2] Econometric models estimated using maximum simulated likelihood are known to be relatively sensitive to starting values, optimization techniques and selection of convergence criteria. Our model is no exception in this respect and to make sure we reached the global maximum in optimization, we used different optimization algorithms, derived gradients analytically and used multiple starting points. In addition, since using longer low-discrepancy sequences (as opposed to shorter sequences or using pseudo-random draws) is found to facilitate reaching the global optimum or revealing identification problems (Chiou and Walker, 2007; Czajkowski and Budziński, 2015) in simulation of the log-likelihood function, we used 10,000 scrambled Sobol draws.

In the modeling, the cost variable was continuous, and other attributes were dummy-coded. The parameters of alternative specific constants and all other attributes, including the cost, were modeled as random. All parameters were assumed to follow normal distributions, except cost, which was assumed to be negative log-normally distributed.[3]

4. Results

4.1. Familiarity and use of information

As hypothesized, the responses showed that many respondents were unfamiliar with several native animal breeds and plant varieties. In general, people had heard about or had experience of native animal breeds more often than plant varieties. Over 30% of respondents had never heard about 5 of the 10 animal breeds and plant varieties presented in the survey. Between 5 to 47% of respondents had no prior knowledge, depending on the breed or variety.

Out of the 1,547 respondents, 64% spent over 30 s reading at least one of the two additional information pages. Table 5 presents the results of the logit model that explained the use of information. The results show that female and older respondents preferentially read additional information. The likelihood of reading the information also increased if the respondent considered the conservation of genetic resources to be the taxpayers' responsibility, but decreased if s/he considered the conservation as the farmers' responsibility. In our case, the importance of preserving native breeds and varieties did not play a role in information acquisition. However, the respondent's familiarity with the native breeds and varieties negatively impacted on the use of the information. This behavior could suggest that those who had the least knowledge and experience at the outset were more likely to obtain additional information in the course of the survey.

4.2. Effects of information on respondents' preferences, scale and willingness to pay (WTP)

We first examined whether the use of information affected the frequency of choosing the status quo alternative or bid acceptance. There was a noticeable difference (p = 0.000) in choosing the status quo alternative between the information groups. Respondents who read/did not read the additional information chose the status quo in 19% and 33% of the choice sets, respectively.

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[3] The models were estimated using a Distributed Computing Environment package, which among other things can be used to estimate MXL models. The package has been developed in Matlab and is available at https://github.com/czaj/DCE. The code and data for estimating the specific models presented in this study are available at http://czaj.org/research/supplementary-materials.

Figure 1 shows the bid acceptance at different cost levels for both information groups. The group who read the information had a larger share of respondents accepting the smaller bids, but there seemed to be no difference between the groups for higher bids.

Next, we turned to investigate the effects of accessing additional information on respondents' preferences and scale. Table 6 presents the results of the MXL models in the preference-space, with correlated parameters[4] in three specifications—assuming that accessing information only causes differences in scale (Model 1), assuming that accessing information can influence means of the preference parameters and scale (Model 2) and allowing for the independent effect for means and standard deviations of preference parameters (Model 3). The models included 9484 observations from 1608 respondents.

The MXL Model 1 (Table 6) included all respondents (both those who read the additional information and those who did not), and there were no assumed differences in preferences between the information groups. However, the mean of the scale parameter was allowed to differ between groups. Most of the conservation parameters in Model 1 were significant and of the expected sign, with increases in the protection of native breeds and varieties increasing utility. The respondents tended to choose policy alternatives instead of the status quo. An increase in the program cost was associated with negative utility, as expected. The highest utility changes resulted from the conservation of plants on farms and gene banks, and cattle breeds on farms. Only the attributes for preserving food plant varieties, native chickens in gene banks, and the lower level of change for increasing the number of sheep breeds on farms were insignificant.

Model 1 indicates that accessing information increases scale, namely, reduces the error term variance. In other words, respondents' choices appear less random from the modeler's perspective. However, the comparison with Model 2, in which parameters of the means of each attribute can depend on whether the information was accessed or not, indicates that Model 1 is overly restrictive. Since the models are nested, one can use the likelihood ratio test to confirm this (see Table 7 for details). As a result, we concluded that the scale results observed in Model 1 are driven by the effect of accessing information on selected mean parameters, as indicated by significant interactions with 'information accessed' in Model 2 (Table 6). In particular, respondents who accessed information were, on average, less likely to choose the status quo, had stronger preferences for increasing the number of food plants and native cattle breeds on

[4] Note that the MXL model with all parameters random and correlated accounts for unobserved scale heterogeneity (Hess and Rose, 2012).

farms, as well as goats in gene banks, and had a significantly lower marginal utility of money (and, hence, an expected higher WTP). Accessing information did not appear to affect the mean preference parameters for other attributes. In addition, once differences in means were controlled, the interaction of scale with a dummy variable for accessing information was no longer significant. Namely, there was no consistent statistical difference in variances of preference parameters between those who did/did not access the additional information.

Model 3, with two information groups, allows for the independent effect of accessing information for the means and standard deviations. A comparison of the parameter estimates between the information groups revealed that not only were many of the attribute coefficients higher but there were also more significant variables for the group that had accessed the additional information relative to those who did not. Moreover, these respondents were less willing to choose the status quo alternative and derived higher utility from improvements related to preserving native food varieties on farms, ornamental varieties in gene banks, and native horse and sheep breeds. The results indicate that those who had familiarized themselves with the information obtained more utility from the improvements compared with those who had not accessed the information. However, based on the likelihood ratio test, there was no significant difference in the model fit between Model 3 and Model 2 ($p = 0.999$).

Next, we compared the differences in the respondents' WTP resulting from accessing additional information. Even though we have established that additional information can influence respondents' preference parameters, this is not necessarily equivalent to causing significant differences in their mean WTP, especially if the effects of preferences for attributes and cost are not proportional. Therefore, we estimated the same three specifications of the MXL model with correlations in the WTP-space. The results, presented in Table 8, can readily be interpreted as marginal WTP (€/year), and show that differences in WTP were fairly consistent with the differences in respondents' preferences. Table 8 summarizes the WTP measures for Model 2 and Model 3. Model 2 shows that in this study, accessing information can be associated with significant differences in the mean WTP for selected attributes, but not necessarily with significant differences in scale or standard deviations of the WTP.

Based on Model 3, we can see that compared to the respondents who did not access the information, those who accessed the information were, on average, willing to pay 6€ more for increasing the number of food plants on farms (from 7 to 2000), approximately 9€ more for banking ornamental plants, and 20€ and 5€ more for banking native goats and horses, respectively. Furthermore, they were willing to pay about 25€ more for increasing the number of native cattle breeds on farms, as well as 12–24€ more for increasing the number of native sheep breeds on farms. At the same time, their implied WTP for the status quo policy was about 44€ lower, indicating that they were generally willing to pay more for implementing the new policy, in comparison with respondents who did not access the additional information.

The WTP for the conservation program with a low level of improvements was 63.38€ for those respondents who did not access the information, whereas, the corresponding value for the respondents who used the information was nearly twice as much (120.26€). When a conservation program with high levels of improvement was considered, the WTP for the group with information not accessed barely changed (67.17€) while for those who accessed information, the WTP further increased to 169.97€.

Overall, the group that accessed information had a higher WTP for all attributes when compared with the group that did not access the information, except for lower improvement of food plants on farms. All other WTP measures were of the expected sign, but the group that did not access the information had a significant and negative WTP for the high improvement level of food plants banked and the low improvement level of native sheep breeds on farms.

5. Discussion and conclusions

This study investigated the voluntary use of additional information and information effects in a CE setting. The empirical application concerned the conservation of agricultural genetic resources (native breeds and varieties) in Finland, an environmental good that is unfamiliar to many people. Respondents were divided into two groups based on the time they spent reading the additional information in the Internet survey. We examined the determinants explaining the use of information using the logit model and the effect of information use on respondents' preferences and scale using the MXL models.

The logit model results suggested that respondents who had read the additional information were more likely to be female, older and perceived the conservation of genetic resources to be the taxpayers' responsibility. The respondents who were more familiar with native animal breeds and plant varieties, and those who felt the conservation was the farmers' responsibility, were less likely to read the additional information. These results are, in part, similar to those of Hu et al. (2009), who modeled information access in a CE for genetically modified food. In that study, male respondents and those who were employed or had a higher income were less likely to access the information, and the more children the household had, the lower the likelihood of information access. Conversely, being a member of a consumer group or a rural resident increased the likelihood of accessing the information.

Altogether, in our study, the respondents showed support for the conservation of native breeds and varieties. However, the results of the MXL models indicate that there was considerable variation in preferences and WTP between those who accessed/did not access the additional information, with voluntary information access being associated with higher welfare estimates. The respondents who had read the additional information chose the status quo alternative less frequently, and their choices could be explained by several environmental attributes characterizing the conservation program of agricultural genetic resources. The choices of the respondents who did not read the information were associated with fewer significant conservation attributes, and the attribute coefficients were lower than in those having read the information.

This finding could indicate that those who have more information on agricultural genetic resources obtain greater benefits from their conservation and that providing the public with additional information on policies to conserve agricultural genetic resources may increase the support of such policies. As our findings pertain to this specific case, their wider applicability to other unfamiliar goods should be investigated. Another possible explanation could be that those respondents who had read the additional information were already more interested in the environmental good and so would be more likely to support the conservation programs, regardless of the information. However, our results do not corroborate this alternative explanation, as information acquisition was not significantly explained by the attitudes toward the importance of conserving agricultural genetic resources.

The findings concerning significant information effects are consistent with several previous studies (e.g., Tisdell and Wilson, 2006; van Til et al., 2009; Chalak and Abiad, 2012; Bieberstein et al., 2013). Although Hu et al. (2009) found an interdependence between information access and product choices, there was a significant variation across individuals.

Our findings indicated that there was no significant difference in the mean scale between the information groups after allowing the mean parameters for the attributes to differ. Even though the covariate of scale was significant in Model 1, it was driven by the effect of accessing information on selected mean parameters, as shown by the comparison with Model 2. These results differ from the ones obtained by Czajkowski et al. (2016), who found that respondents who were given more information in the CE made less random choices. Also, in contrast to Christie and Gibbons (2011), who stated that it is important to control the scale heterogeneity when the good in question is unfamiliar to the respondents, we did not find significant scale heterogeneity after the mean parameters for the attributes were allowed to differ.

Even though the information affected respondents' choices, some attribute coefficients for the conservation program were similar across models and information groups. These attributes included conservation of plants on farms, horses in gene banks, as well as cattle breeds on farms. Willingness to support the conservation programs was lower for the group that did not read the information compared with those who read the information, especially at low-cost levels.

Although we found significant differences between the information groups, defined based on the time spent reading the additional material, setting the cut-off time to 30 s was arguably arbitrary. Future research should investigate ways of properly identifying how much effort respondents actually put into reading the provided material, in stated preference surveys. More information is required on information effects in CE, for example, examining the relationship between uncertainty and information access, and whether information use affects respondent uncertainty.

Czajkowski et al. (2016) raised the issue of how well-informed preferences should be before they are used for cost–benefit analysis or policy-making, and how much information should be provided to the survey respondents. Our results showed that even though neutral information was available, only about 60% of respondents studied the information and used the opportunity to familiarize themselves more with the environmental good. What was promising, was that the respondents who were not familiar with the good at the outset were more interested in reading the information. This outcome is encouraging from a policy standpoint, as it suggests that the share of well-informed respondents can be increased by providing access to additional voluntary information.

In the conservation of agricultural genetic resources, there are no strong disagreements between stakeholder groups. An interesting future topic would be to examine how respondents use information from different standpoints; whether they tend to select the information that is congruent with their existing perceptions or extend their understanding with a new type of information that could, however, make the choice process more demanding.

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Table 1. Sociodemographic profile of respondents and population

Sociodemographic characteristic	In the data	In the population[a]
Proportion of females, %	48	51
Mean age, years	52	47
Proportion of people with a higher educational level, %	24	23
Proportion of people living in households with a gross income under €40,000, %	43	53
Proportion of people with children (<18 years) in the family, %	35	40
Proportion of people living in Southern Finland, %	40	41

[a] *Source:* Statistics Finland (2010; www.stat.fi)

Table 2. Attributes of conservation programs and their levels

Attribute	Description	Current state/status quo	Level (unit)
Native food plant varieties in gene banks	Native food plants are stored in a gene bank, either as seeds or plant parts.	The gene bank contains seeds from about 300 landrace varieties. Plants that are added vegetatively (e.g., berry and apple varieties) are missing.	300, 400, 500 (number of plants)
Farms growing native food plants	Farmers and hobby gardeners cultivate native food plants on farms or in gardens.	Seven farms grow seeds of native food plants with agri-environmental support. Other activities than growing seeds are not supported.	7,500,1000 (number of farms)
Native ornamental plant varieties mapped and in gene banks	Scientists identify and register native ornamental plants. Varieties are preserved in a gene bank, either as seeds or plant parts.	Only a small proportion of the native ornamental plants are known. Storage in the official gene bank is not provided.	small proportion, about half, majority (proportion of plants)
Native breeds in gene banks	Landrace breeds are kept in a gene bank as gametes and embryos.	The gene bank contains Western, Eastern and Northern Finncattle, as well as Finnsheep, and Åland and Kainuu sheep. Native chicken, goat and horse breeds are missing from the gene bank.	3 cattle breeds and 3 sheep breeds (status quo level), + all combinations of goat, horse and chicken breeds (breeds)
Native breeds on farms	Native breeds are kept on farms in their natural environment. A breed is considered to be endangered if the number of females is less than 1000.	Farms secure goat, horse and chicken breeds, Finnish sheep and Western Finncattle. Eastern and Northern Finncattle, as well as Åland and Kainuu sheep, are endangered.	1 cattle breed, 1 sheep breed, goat, horse and chicken (status quo level), + all combinations of additional 1-2 cattle and sheep breeds (breeds)
Cost	Cost for taxpayers, €/year during 2012–2021.	No additional costs.	0, 5, 20, 40, 80, 100, 150, 300 (€)

Table 3. Example of a choice set

Attribute	Current state	Conservation program A	Conservation program B
Native food plant varieties in gene banks	Approximately 300	400	400
Farms growing native food plants	7 farms	2000 farms	1000 farms
Native ornamental plant varieties mapped and in gene banks	Some	Majority	About half
Native breeds in gene banks	3 cattle breeds 3 sheep breeds	3 cattle breeds 3 sheep breeds Chicken Goat Horse	3 cattle breeds 3 sheep breeds Goat
Native breeds on farms	Goat Horse Chicken Finnsheep Western Finncattle	Horse 3 cattle breeds 3 sheep breeds	Goat Horse Chicken 3 cattle breeds 3 sheep breeds
Cost for taxpayer €/year during 2012–2021	€0/year	€80/year	€200/year
I support the alternative	( )	( )	( )

Table 4. Variables used in the logit model

Variable	Description	Mean	Standard deviation	Min	Max
Information	Time spent in at least one of the additional information pages is more than 30 seconds	0.64	0.48	0	1
Gender	1 if female, 0 if male	0.48	0.50	0	1
Age	Respondent´s age, continuous	52.31	14.28	19	80
Income	Household gross income (thousands €/year), continuous	49.45	24.04	5.00	95.00
Landowner	1 if respondent owns forest, croplands or home garden, 0 otherwise	0.59	0.49	0	1
High education	1 if the respondent has a university or polytechnic education, 0 otherwise	0.30	0.46	0	1
Taxpayer responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.38	2.30
Citizen responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.38	2.28
Farmer responsibility	Factor score based on nine measures of stakeholder responsibilities in conservation[a]	0	1	-3.12	2.88
Familiarity	The familiarity of native breeds and varieties to the respondent (1 has not heard of, 2 has heard of, 3 has used/tried/experience with)	2.03	0.42	1	3
Importance	The importance of preserving native breeds and varieties (4 very important – 1 not at all important)	3.09	0.71	1	4

[a]Detailed description of these variables can be found in Tienhaara et al. (2015)

Table 5. Logit model results for the use of information

Variable	Coefficient	Standard error	Odds ratio
Constant	0.752*	0.456	2.121
Gender (male)	-0.730***	0.127	0.482
Age	0.014***	0.005	1.014
Income	0.050	0.136	1.052
Landowner	0.030	0.127	1.031
High education	0.050	0.136	1.052
Taxpayer responsibility	0.286***	0.063	1.332
Consumer responsibility	0.074	0.068	1.077
Farmer responsibility	-0.278***	0.061	0.757
Familiarity	-0.292*	0.168	0.747
Importance	0.051	0.096	1.052
N	1354		
Nagelkerke R^2	0.089		
Correct predictions	68%		

Variables are significant at the ***1%, **5% and *10% levels.

Table 6. Results of the mixed logit (MXL) models—the effects of accessing information on the respondents' preferences and scale (standard errors in parentheses)

	MXL Model 1		MXL Model 2			MXL Model 3			
Variable	**Mean**	**Standard deviation**	**Mean**	**Interaction with 'information accessed'**	**Standard deviation**	**Mean 'information not accessed'**	**Standard deviation 'information not accessed'**	**Mean 'information accessed'**	**Standard deviation 'information accessed'**
ASC (status quo)	-4.4850*** (0.4070)	5.5511*** (0.5318)	-3.1538*** (0.5112)	-3.3454*** (0.6496)	6.2380*** (0.6312)	-3.5692*** (0.6337)	7.3236*** (0.9922)	-6.1497*** (0.5288)	5.7934*** (0.6743)
Food plants banked 300 -> 400	-0.0532 (0.0752)	0.8983*** (0.1439)	-0.0443 (0.1490)	-0.0214 (0.1792)	1.0910*** (0.1839)	0.0327 (0.1647)	0.6261*** (0.2589)	-0.1093 (0.1124)	1.2196*** (0.2194)
Food plants banked 300 -> 500	-0.0328 (0.0777)	0.3971*** (0.1237)	-0.0842 (0.1572)	0.0607 (0.1822)	0.5671*** (0.1850)	-0.0870 (0.1927)	0.9331*** (0.2776)	-0.1069 (0.1156)	0.9196*** (0.1925)
Food plants on farms 7 -> 1000	0.5156*** (0.0862)	1.1386*** (0.1579)	0.3205** (0.1510)	0.4896** (0.1904)	1.4330*** (0.2490)	0.5023*** (0.1866)	1.6040*** (0.3405)	0.7003*** (0.1156)	1.4205*** (0.2220)
Food plants on farms 7 -> 2000	0.4823*** (0.0805)	1.1521*** (0.1218)	0.3370** (0.1410)	0.4042** (0.1725)	1.4594*** (0.2090)	0.5346*** (0.1704)	1.4439*** (0.2371)	0.6138*** (0.1103)	1.6122*** (0.1784)
Ornamental plants banked some -> half	0.3287*** (0.0785)	0.9614*** (0.1292)	0.2776** (0.1416)	0.2014 (0.1724)	1.2273*** (0.1803)	0.3126* (0.1749)	1.5594*** (0.2663)	0.3729*** (0.1093)	1.1914*** (0.1960)
Ornamental plants banked some -> majority	0.3002*** (0.0778)	1.1419*** (0.1259)	0.2441* (0.1464)	0.1961 (0.1727)	1.4396*** (0.1734)	0.2393 (0.1864)	1.9244*** (0.2810)	0.4137*** (0.1116)	1.6473*** (0.2936)
Native horses banked	0.2399*** (0.0538)	0.6793*** (0.0920)	0.1868* (0.0983)	0.1771 (0.1182)	0.8566*** (0.1268)	0.2008 (0.1263)	1.1537*** (0.2004)	0.3204*** (0.0733)	0.8592*** (0.1529)
Native goats banked	0.1881*** (0.0505)	0.5800*** (0.1041)	0.0255 (0.0949)	0.3054*** (0.1128)	0.7017*** (0.1387)	0.1001 (0.1198)	0.9774*** (0.1778)	0.2900*** (0.0717)	0.8684*** (0.1435)
Native chickens banked	0.0755 (0.0548)	0.8949*** (0.1278)	0.0412 (0.1064)	0.0516 (0.1231)	1.1438*** (0.1678)	0.1017 (0.1356)	1.3835*** (0.2345)	0.0783 (0.0782)	1.2700*** (0.3301)
Native cattle breeds on farms 1 -> 2	0.2231*** (0.0723)	1.1389*** (0.1563)	-0.0790 (0.1346)	0.5195*** (0.1635)	1.4225*** (0.2074)	-0.0601 (0.1685)	1.6743*** (0.2635)	0.3670*** (0.1051)	1.7404*** (0.4899)
Native cattle breeds on farms 1 -> 3	0.2085*** (0.0689)	1.0317*** (0.1496)	-0.1159 (0.1302)	0.5725*** (0.1598)	1.2748*** (0.1894)	-0.0860 (0.1563)	1.4891*** (0.2562)	0.4080*** (0.0990)	1.4475*** (0.2920)
Native sheep breeds on farms 1 -> 2	0.0384 (0.0698)	1.1419*** (0.1773)	-0.0179 (0.1325)	0.1109 (0.1557)	1.5157*** (0.2404)	0.0086 (0.1672)	1.9440*** (0.3351)	0.0191 (0.1022)	1.8885*** (0.6129)
Native sheep breeds on farms 1 -> 3	0.1940*** (0.0736)	1.3742*** (0.2293)	0.1506 (0.1384)	0.1330 (0.1622)	1.7343*** (0.2819)	0.0768 (0.1731)	1.8998*** (0.3414)	0.2527** (0.1127)	2.4775*** (0.9077)
- Cost (EUR)	3.5236*** (0.4943)	16.8138** (7.8100)	2.8463*** (0.5303)	0.6695*** (0.1637)	14.4326** (6.8451)	5.3564*** (1.7819)	79.8477 (73.6185)	3.9625*** (0.4823)	12.5230*** (4.4238)
Covariates of scale									
'Info accessed'	0.2396** (0.0941)		-0.0551 (0.1004)						
Model diagnostics									
LL at convergence	-7222.80		-7172.20			-7129.67			

LL at constant(s) only	-10141.25	-10141.25	-10141.25
McFadden's pseudo-R^2	0.2878	0.2928	0.2965
Ben–Akiva–Lerman's pseudo-R^2	0.4854	0.4886	0.4944
AIC/*n*	1.5518	1.5443	1.5605
BIC/*n*	1.6545	1.6583	1.6178
n (observations)	9484	9484	9484
r (respondents)	1608	1608	1608
k (parameters)	136	151	270

The variables are significant at the ***1%, **5% and *10% levels.
ASC: alternative specific constant.

Table 7. Likelihood ratio test results for the comparisons of different mixed logit model specifications in the preference space

Comparison	Test statistics	Degrees of freedom	*P*-value
Model 1 vs. Model 2	101.1997	15	0.0000
Model 1 vs. Model 3	176.0196	134	0.0087
Model 2 vs. Model 3	74.8199	119	0.9995

Table 8. Results of the mixed logit (MXL) models—the effects of accessing information on the respondents' willingness to pay (results in €, standard errors in parentheses)

	MXL Model 1		MXL Model 2			MXL Model 3			
Variable	Mean	Standard deviation	Mean	Interaction with 'information accessed'	Standard deviation	Mean 'information not accessed'	Standard deviation 'information not accessed'	Mean 'information accessed'	Standard deviation 'information accessed'
ASC (status quo)	-294.45*** (15.09)	318.72*** (22.31)	-233.13*** (19.95)	-99.88*** (22.32)	296.59*** (20.00)	-259.61*** (10.04)	428.74*** (25.18)	-303.52*** (22.02)	263.76*** (21.62)
Food plants banked 300 -> 400	-1.41 (4.31)	50.11*** (6.09)	5.64 (7.54)	-5.62 (8.94)	49.38*** (5.73)	3.86 (4.08)	54.88*** (4.73)	-0.94 (5.93)	51.07*** (5.42)
Food plants banked 300 -> 500	2.54 (4.27)	21.84*** (6.65)	3.39 (8.23)	-0.53 (9.48)	27.23*** (5.87)	-13.01*** (4.89)	45.92*** (7.02)	4.27 (5.40)	24.14*** (5.28)
Food plants on farms 7 -> 1000	51.19*** (5.82)	85.49*** (6.46)	35.12*** (8.29)	20.13** (8.88)	81.51*** (5.96)	56.18*** (8.52)	93.16*** (6.38)	51.42*** (6.51)	78.29*** (6.41)
Food plants on farms 7 -> 2000	43.49*** (5.61)	91.27*** (6.31)	38.20*** (7.35)	11.52 (8.20)	88.98*** (6.04)	41.29*** (7.08)	102.02*** (5.13)	47.25*** (5.85)	86.15*** (6.60)
Ornamental plants banked some -> half	28.46*** (5.77)	80.57*** (6.30)	31.03*** (7.96)	1.78 (8.30)	79.94*** (6.09)	21.55*** (7.53)	118.66*** (6.95)	32.78*** (6.29)	70.11*** (6.02)
Ornamental plants banked some -> majority	26.23*** (6.08)	84.15*** (5.93)	27.58*** (8.05)	0.42 (8.53)	80.53*** (5.67)	20.76** (8.29)	127.66*** (6.10)	29.03*** (6.46)	69.80*** (6.01)
Native horses banked	19.17*** (3.76)	45.66*** (4.25)	18.60*** (6.00)	2.73 (5.71)	45.95*** (4.08)	18.13*** (5.67)	60.27*** (4.80)	22.90*** (4.25)	43.16*** (4.44)
Native goats banked	15.52*** (3.47)	34.47*** (3.88)	05.07 (5.30)	14.28*** (5.47)	33.49*** (4.02)	2.10 (5.86)	55.90*** (3.88)	20.44*** (3.72)	29.53*** (3.70)
Native chickens banked	3.21 (3.74)	40.28*** (3.27)	-2.04 (5.81)	4.42 (6.05)	42.66*** (3.62)	7.22 (5.81)	60.78*** (3.11)	2.54 (4.02)	28.10*** (3.30)
Native cattle breeds on farms 1 -> 2	22.70*** (4.84)	53.71*** (4.74)	0.83 (7.60)	26.55*** (7.92)	51.92*** (5.57)	3.77 (8.01)	92.98*** (4.21)	24.35*** (5.45)	41.07*** (3.95)
Native cattle breeds on farms 1 -> 3	20.15*** (5.15)	48.40*** (5.30)	0.17 (7.03)	27.32*** (7.65)	40.68*** (4.82)	2.39 (7.27)	75.81*** (3.39)	26.58*** (5.69)	38.45*** (4.71)
Native sheep breeds on farms 1 -> 2	6.57 (5.32)	58.57*** (5.55)	11.84 (7.82)	-3.21 (7.51)	63.78*** (5.37)	-14.35* (7.97)	93.28*** (5.22)	11.71** (5.79)	58.03*** (5.05)
Native sheep breeds on farms 1 -> 3	20.18*** (5.71)	68.58*** (5.79)	21.78** (8.55)	-0.93 (8.53)	69.95*** (5.99)	-5.42 (8.18)	109.92*** (7.05)	23.77*** (6.12)	63.83*** (5.03)
Model diagnostics									
LL at convergence	-7364.35		-7335.16			-7129.67			

LL at constant(s) only	-10141.25	-10141.25	-10141.25
McFadden's pseudo-R^2	0.2738	0.2767	0.2965
Ben–Akiva–Lerman's pseudo-R^2	0.4797	0.4814	0.4944
AIC/*n*	1.5817	1.5785	1.5605
BIC/*n*	1.6843	1.6917	1.6178
n (observations)	9484	9484	9484
r (respondents)	1608	1608	1608
k (parameters)	136	150	270

The variables are significant at the ***1%, **5% and *10% levels.
ASC: alternative specific constant.

Table 9. Likelihood ratio test results for the comparisons of different mixed logit model specifications in the willingness to pay space

Comparison	Test statistics	Degrees of freedom	*P*-value
Model 1 vs. Model 2	101.1997	15	0.0000
Model 1 vs. Model 3	176.0196	134	0.0087
Model 2 vs. Model 3	74.8199	119	0.9995

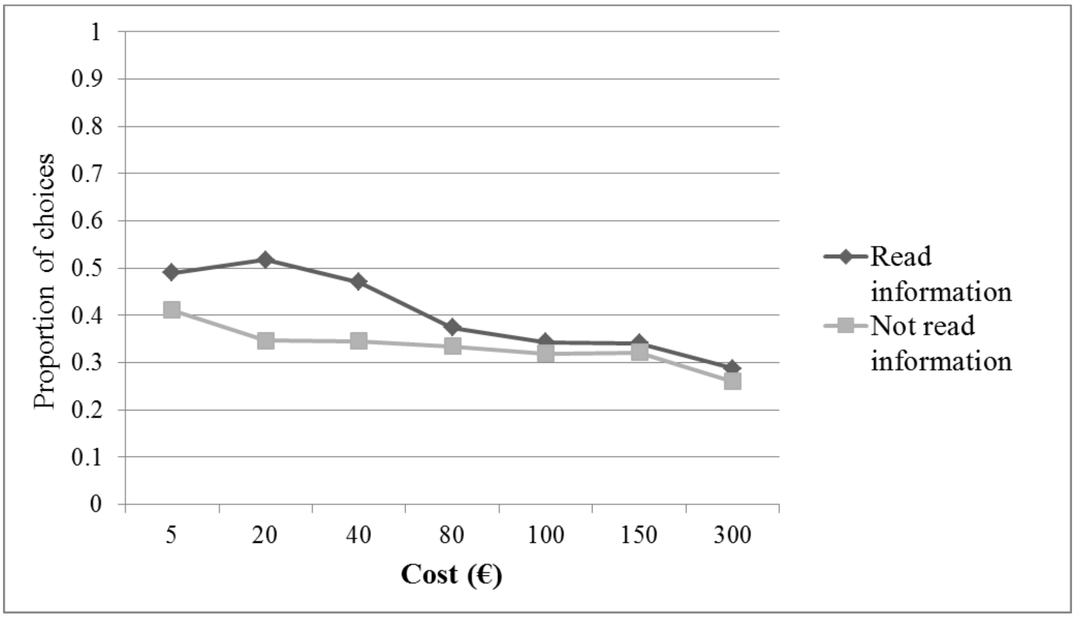

Fig. 1. Bid acceptance from the three alternatives in a choice set at different cost levels for the two information groups

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