Using a Choice Experiment to Account for Preference Heterogeneity in Wetland Attributes: The case of Cheimaditida wetland in Greece

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Abstract

This paper aims to assist policy makers in formulating efficient and sustainable wetland management policies in accordance with the Ramsar Convention and the European Union Water Framework Directive (2000/60/EC), by providing results of a valuation study on the Cheimaditida wetland in Greece. A choice experiment is employed to estimate the values of changes in several ecological, social and economic functions that Cheimaditida wetland provides to the Greek public. In addition to the conditional logit model, a random parameter logit model, a random parameter logit model with interactions and a latent class model are estimated to account for heterogeneity in the preferences of the public for the various functions of the wetland. The results reveal that there is considerable preference heterogeneity across the public and on average they derive positive and significant values from sustainable management of this wetland. The estimated economic benefits of sustainable wetland management are weighed against the costs of alternative wetland management scenarios. Results of this cost benefit analysis can aid in the design of socially optimal policies for sustainable management of the Cheimaditida wetland, with possible implications for other similar wetlands in Greece and the rest of Europe.

Keywords: Choice experiment, wetlands, conditional logit model, random parameter logit model, interactions, latent class model.

JEL Classifications: Q25, Q51, Q53, Q57

1. Introduction

Wetlands are amongst the Earth's most productive ecosystems, providing a diverse array of important ecological functions and services, ranging from flood and flow control to groundwater recharge and discharge, water quality maintenance, biodiversity, carbon sequestration and other life-support functions. These ecological functions and services translate directly into economic functions and services such as flood protection, water supply, improved water quality, commercial and recreational fishing and hunting, and the mitigation of global climate change (Barbier et al., 1997; Woodward and Wui, 2001; Brouwer et al., 2003; Brander et al., 2006).

Historically, many wetlands have been treated as wastelands and drained or otherwise degraded (Barbier et al., 1997). To this day, they are under increasing pressure from anthropogenic activities such as conversion to intensive agricultural, industrial and residential uses; drainage as a result of excessive irrigation in agriculture; and pollution due to nutrient run-off from intensive agricultural production, and industry. Other factors adversely affecting the sustainable management of wetlands include poverty and economic inequality, pressure from population growth, immigration and mass tourism, and social and cultural conflicts (Skourtos et al., 2003).

Though the amount of wetland area lost is difficult to quantify due to uncertainty in the total area of wetlands in the world, there are some figures indicating the scale of the problem. In Europe, 50 to 60% of wetlands have been lost in the past century while the United States has witnessed a 54% loss of its original wetlands (MEDWET, 1996; Barbier et al., 1997). Alarmed by the accelerated rate of wetland loss and degradation, in 1971 100 countries created the Ramsar Convention on Wetlands of International Importance, providing the framework for national action and international cooperation for the 'conservation and wise use' of wetlands and their resources (Ramsar, 1996).

In addition to this international effort, there are also European Union (EU) level policies asserting that there should be no further wetland loss or degradation. The Article 1(a) of the EU Water Framework Directive (WFD) (2000/60/EC) clearly identifies the protection, restoration and enhancement of the water needs of wetlands as part of its purpose and stresses the EU's involvement in wetland protection and enhancement and its commitment in setting up strategic policies for these purposes. Further to the WFD, there are other EU level regulations, such as the EU Birds Directive (79/409/EEC) and the EU Habitats Directive (92/43/EEC), which aim to conserve several ecological functions that are provided by wetlands.

The growing number of valuation studies on this environmental resource also reflects increasing recognition of the importance of wetlands. Heimlich et al. (1998), Kazmierczak (2001), and Boyer and Polasky (2004) provide an extensive overview of wetland valuation studies which include a broad variety of valuation techniques, such as the contingent valuation (CV), hedonic price, replacement value, damage avoided and production value methods. Given the large number of wetland valuation studies that are now available, three meta-analyses have been conducted. Woodward and Wui (2001) use 39 wetland valuation studies, which employ net factor input, travel cost, replacement cost and CV methods, in their meta-analysis, whereas Brouwer et al. (2003) carry out a meta-analysis of 30 CV applications. Most recently, Brander et al. (2006) employ results from 190 wetland valuation studies, which use a broad range of methods including opportunity cost, market prices, production function, net factor income, replacement cost, travel cost method, hedonic pricing method and CV.

This paper contributes to the wetland valuation literature by applying a state-of-the-art valuation method to a case study in Greece, where the application of valuation studies is very limited. Indeed, of the wetland valuation studies reviewed, only three are specific to Greece. Kontogianni et al. (2001) conduct a CV study to evaluate different stakeholders' preferences of four development/conservation scenarios for the wetland surrounding the Kalloni Bay on the island of Lesvos. Oglethorpe and Miliadou (2000) employ the CV method to estimate the use and non-use values of Lake Kerkini in Northern Greece. The CV study by Psychoudakis et al. (2005) estimate the use values of the several ecological functions of the Zazari-Cheimadidita wetland, including flood water retention, food web support, groundwater recharge, nutrient export and sediment retention.

The aim of this study is to provide policy-makers with much needed information on the economic value of the benefits generated by the sustainable management of the Cheimaditida wetland. The economic value of the changes in the ecological, social and economic conditions of the wetland is estimated with a recently developed non-market valuation technique, namely the choice experiment (CE) method. There are to date only a few CE applications to wetlands and to our knowledge, the study presented here is the first application of a CE in Greece. The existing wetland valuation studies that use the CE method include those by Morrison et al. (1999) on the Macquarie Marshes wetland in Australia; Carlsson et al. (2003) on the Staffanstorp wetland in Sweden; Othman et al. (2004) on the Matang Mangrove Wetlands in Perak State in Malaysia, and Whitten and Bennett (2005) on the wetlands in Upper South East of South Australia. The CE on the Cheimaditida wetland presented here provides a valuable addition to this scant literature.

Greece has lost 63% of its wetlands between 1920 and 1991 (Barbier et al., 1997) and as a signatory to the Ramsar convention and an EU member state it is obliged to sustainably manage and improve the conditions of its remaining wetlands. The case study is the Cheimaditida wetland, which provides several of the important ecological functions described above. The value of the economic benefits generated by sustainable management of the wetland is estimated using data from 407 CE surveys that were administered in 10 cities and towns in Greece. The results reveal that overall the Greek public derive positive and significant benefits from sustainable management of several ecological, social and economic functions of the wetland including biodiversity, open water surface area, research and educational opportunities from the wetland, and locals re-trained in environmentally friendly employment. There is, however, a considerable level of heterogeneity in the public's preferences for these functions. The estimated benefit values are used in a cost-benefit analysis of alternative wetland management scenarios, to determine the management strategy that maximises social welfare.

The paper is organised as follows: The next section describes the Cheimaditida case study site. Section 3 describes the choice experiment design and administration. The results of the econometric and cost-benefit analyses are reported in section 4, and section 5 concludes the paper.

2. The Cheimaditida Wetland

The case study in this paper is the Cheimaditida wetland, located 40 km Southeast of Florina in Northwest Greece. This wetland includes Lake Cheimaditida, one of the few remaining freshwater lakes in Greece, and constitutes a total wetland area of 168 km^2 surrounded by extensive marshes with reeds (*Phragmites sp.*). The wetland is rich in flora, fauna and habitat diversity. It supports six habitat types listed under Annex I of the EU Habitats Directive (92/43/EEC), one of which is a *priority natural habitat* under Article 1, namely habitat type 7210 Calcareous fens with *Cladium mariscus* and *Carex davalliana*. Of the 150 relatively rare plant species in the wetland, 8 are Balkan endemic, 12 are only found in the Mediterranean Region and 6 are listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The wetland also supports a wide array of fauna diversity, including 11 mammals, 7 amphibians, 7 reptiles and 8 fish, most of which are listed under Annex II and IV of the EU Habitats Directive (92/43/EEC). Further, the Cheimaditida wetland is recognised as an 'Important Bird Area' with approximately 140 identified bird species. Most of these are under protection, including the globally threatened species Dalmatian pelican (*Pelecanus crispus*), Ferruginous duck (*Aythya nyroca*) and the lesser kestrel (*Falco naumanni*) (M. Seferlis, personal communication, 2004).

Within the wetland the main economic activities include agriculture, forestry and fishing. Agriculture is a vital activity where alpha-alpha and maize are the main cash crops whose production is water and fertiliser intensive. Water opportunities from the lake for irrigation in agriculture, and pollution due to run-off from agricultural production, have adverse effects on water quantity and quality. These in turn affect the level of biodiversity that the wetland is able to support. Current local employment in agriculture supported by the wetland is estimated at 1470 persons. This is expected to fall as declining quality and quantity of water will no longer be able to support the current number of locals (M. Seferlis, personal communication 2004; Psychoudakis et al., 2005).

3. Choice Experiment Design and Application

3.1. Choice Experiment Design

The first step in CE design is to define the good to be valued in terms of its attributes and their levels. The good to be valued in this CE study is the wetland management scenario. Significant wetland management attributes pertaining to the Cheimaditida wetland were identified in consultation with ecologists and hydrologists at the Greek Centre for Biotopes and Wetlands (EKBY) and agricultural and environmental economists at the Aristotle University of Thessaloniki. Three focus groups were then conducted with the members of the Greek public to determine the final attributes and their levels that are important to the public, as well as the vocabulary and language to be used in the survey.

The selected attributes and their levels are reported in Table 1. Economic benefits may be derived from social and economic factors in addition to the ecological factors (Portney, 1994). Several studies have included social and economic factors, such as number of people employed or living in the countryside, in CE studies to capture the economic benefits enjoyed by wider public from provision of such factors (e.g., Morrison et al., 1999; Bennett et al., 2004; Othman et al., 2004; Colombo et al., 2005; Bergmann et al., 2006). In the CE presented here, two ecological and two social and economic attributes were selected to reflect the variety of economic benefits generated by the wetland. The former are biodiversity and open water surface area, and the latter are the inherent research and educational values that can be provided by the wetland, and the social values associated with re-training of locals in environmentally friendly employment. Many species of animals, plants and their habitats depend on wetlands for their continued existence. To date the majority of the economic values associated with wetlands have been attributed to biodiversity (see, e.g., Brouwer et al., 2003; Brander et al., 2006). Open water surface area and the natural vistas associated with them are expected to create benefits through feelings of serenity and tranquillity. Further, higher open water surface areas provide water quantity required for sustaining the wetland's biodiversity. Research and educational opportunities from the wetland is expected to contribute to social and economic values associated with cultural heritage and scientific knowledge. Finally, re-training of locals in environmentally friendly employment is expected to generate social and economic values to the wider public.

The fifth attribute included in the CE is a monetary one, which is required to estimate welfare changes. The levels of the monetary attribute used in the CE and the payment vehicle employed were determined through an open-ended pilot contingent valuation survey (Birol et al., 2006). The payment vehicle was a one-off increase in taxes for the year 2006-2007 to be channelled to a 'Cheimaditida Wetland Management Fund', which would be managed by a trustworthy and independent body. Taxation was preferred over voluntary donations since respondents may have the incentive to free-ride with the latter (Whitehead, 2006), a point which was also brought up by the focus group participants, who did not reveal any major objections to the payment vehicle employed. The payment levels used are €3, €10, €40 and €80.

[Table 1]

A large number of unique wetland management scenarios can be constructed from this number of attributes and levels[1]. Experimental design techniques (see Louviere *et al.*, 2000) and SPSS Conjoint software were used to obtain an orthogonal design, which consisted of only the main effects, and resulted in 32 pair wise comparisons of alternative wetland management scenarios. These were randomly blocked to 4 different versions, each with 8 choice sets. Each set contained two wetland management scenario profiles and an option to select neither scenario. Such an "opt out" option can be considered as a *status quo* or baseline alternative, whose inclusion in the choice sets is instrumental to achieving welfare measures that are consistent with demand theory (Louviere et al., 2000; Bennett and Blamey, 2001; Bateman et al., 2003). The respondents were explained that if they chose the neither scenario option, they would not be expected to pay, however there would not be any active wetland management, in which case the conditions at the wetland would deteriorate to low levels for biodiversity, open water surface area and research and education attributes (as defined in Table 1), and no locals would be re-trained in environmentally friendly employment. An example of a choice set is presented in Figure 1.

[Figure 1]

3.2. Choice Experiment Data Collection

The CE survey was administered in February and March of 2005 with face-to-face interviews. The survey design consisted of two stages. In the first stage 8 towns (Amyntaio, Ptolemaida, Florina, Edessa, Kozani, Veroia, Naoussa, Chalkithona) and two cities (Athens and Thessaloniki), were selected. These locations were chosen so as to represent a continuum of distances from the Cheimaditida wetland, as well as rural and urban population. This design encompasses 60% of the Greek adult population, with a sampling frame of 5 383 5600. This stratified design enables

[1] The number of wetland management scenarios that can be generated from 5 attributes, 2 with 4 levels and the remaining 3 with 2 levels, is $4^2*2^3=128$.

testing of the hypotheses about the impacts of the respondents' social, economic and attitudinal characteristics and location on their valuation of the changes in conditions of the Cheimaditida wetland.

In the second stage, randomly selected individuals were surveyed in each of the city and town centres. The CE survey was administered to be representative of the Greek population in terms of gender and age, and only individuals aged 18 years or older were surveyed. During the interviews a map of the wetland location and colour photographs were shown to each respondent. Enumerators described the Cheimaditida wetland, its location, ecological importance and threats to its existence, and reminded the respondents of their budget constraints and of alternative wetlands and other environmental goods in Greece. Finally, the enumerators also explained that the attributes of the wetland management scenarios were selected as a result of prior research and were combined artificially, and each attribute was defined to ensure uniformity in understanding. A total sample of 700 respondents was envisaged and it was distributed between the 10 locations proportionately to their population levels. Across the 10 locations, overall 58% of the sample approached agreed to take part in the survey, and a total of 407 respondents were interviewed.

In addition to the CE questions, data on the respondents' social and economic characteristics, and environmental attitudes were collected. This information is required so as to assess the representativeness of the sample of the Greek public, as well as to use these data as explanatory variables to investigate heterogeneity in preferences. The descriptive statistics of the sample are presented in Table 2.

[Table 2]

The social and economic characteristics of the sample are similar to those of the Greek population with the exception of income, employment, the percentage of respondents with children, and education. The former is partly due to the fact that incomes in Athens and Thessaloniki are significantly higher than the Greek average. With respect to the percentage of respondents with children, the sample average is lower because a large proportion of the respondents were students, which also explains the high proportion of respondents with university degrees.

The attitudes of the respondents for environmental issues were elicited through a series of questions on their purchase of organic produce, environmental publications, fair-trade and environmentally friendly products, and recycling. These were measured on a Likert-scale ranging from zero (never) to 4 (always). Respondents were also asked whether they are a member of an environmental group. An environmental consciousness index (ECI), ranging from 0 to 20, was calculated using the Likert scores and environmental group membership.

4. Results

4.1. Conditional Logit Model

The CE method has its theoretical grounding in Lancaster's model of consumer choice (Lancaster, 1966), and its econometric basis in random utility theory (Luce, 1959; McFadden, 1974). Lancaster proposed that consumers derive satisfaction not from goods themselves but from the attributes they provide. To illustrate the basic model behind the CE presented here, consider a respondent's choice for a wetland management scenario and assume that utility depends on choices made from a set C, i.e., a choice set, which includes all the possible wetland management scenario alternatives. The respondent is assumed to have a utility function of the form:

$$U_{ij} = V(Z_j, S_i) + e(Z_j, S_i) \qquad (1)$$

where for any respondent *i,* a given level of utility will be associated with any wetland management scenario alternative *j*. Utility derived from any of the wetland management scenario alternatives depends on the attributes of the wetland management scenario (Z_j), -i.e., biodiversity, open water surface area, research and education, re-training of farmers, and the monetary payment-, and the social, economic and attitudinal characteristics of the respondent (S_i).

The random utility theory (RUT) is the theoretical basis for integrating behaviour with economic valuation in the CE method. According to RUT, the utility of a choice is comprised of a deterministic component (*V*) and an error component (*e*), which is independent of the deterministic part and follows a predetermined distribution. This error component implies that predictions cannot be made with certainty. Choices made between alternatives will be a function of the probability that the utility associated with a particular option *j* is higher than those for other alternatives. Assuming that the relationship between utility and attributes is linear in the parameters and variables function, and that the error terms are identically and independently distributed with a Weibull distribution, the probability of any particular alternative *j* being chosen can be expressed in terms of a logistic distribution. Equation (1) can be estimated with a conditional logit (CL) model (McFadden 1974; Greene 1997 pp. 913-914; Maddala 1999, pp. 42), which takes the general form:

$$P_{ij} = \frac{\exp(V(Z_{ij}, S_i))}{\sum_{h \in C} \exp(V(Z_{ih}, S_i))} \qquad (2)$$

where the conditional indirect utility function generally estimated is:

$$V_{ij} = \beta + \beta_1 Z_1 + \beta_2 Z_2 + ... + \beta_n Z_n + \delta_1 S_1 + \delta_2 S_2 + ... + \delta_l S_m \qquad (3)$$

where β is the alternative specific constant (ASC) which captures the effects on utility of any attributes not included in choice specific attributes. The number of wetland management scenario attributes considered is *n* and the number of social, economic and attitudinal characteristics of the respondent employed to explain the choice of the wetland management scenario is *m*. The vectors of coefficients β_1 to β_n and δ_1 to δ_l are attached to the vector of attributes (*Z*) and to vector of interaction terms (*S*) that influence utility, respectively. Since social, economic and attitudinal characteristics are constant across choice occasions for any given respondent, these only enter as interaction terms with the wetland management scenario attributes.

The CE was designed with the assumption that the observable utility function would follow a strictly additive form. The model was specified so that the probability of selecting a particular wetland management scenario was a function of attributes of that scenario and of the alternative specific constant (ASC), which was specified to equal 1 when either management scenario A or B was selected, and to 0 when the 'neither management scenario' option was selected. Using the 3256 choices elicited from 407 respondents, four basic CL models (McFadden, 1974; Greene, 1997 pp. 913-914; Maddala, 1999, pp. 42) with logarithmic and linear specifications for the attributes with four levels were estimated and compared using LIMDEP 8.0 NLOGIT 3.0. The highest value of the log-likelihood function was found for the specification with both four-levelled attributes in linear form. The results of the CL estimates for the sample are reported in the first column of Table 3.

Although the overall fit of the model, as measured by McFadden's ρ^2, is low by conventional standards used to describe probabilistic discrete choice models[2] (Ben-Akiva and Lerman, 1985), the coefficients are highly significant at less than 1% level and all the signs are as expected _a priori_. All of the wetland management attributes are significant factors in the choice of a wetland management scenario, and _ceteris paribus_ any single attribute increases the probability that a management scenario is selected. In other words, the respondents prefer those wetland management scenarios, which result in higher levels of biodiversity, open water surface area, research and education opportunities and locals re-trained in environmentally friendly employment. The sign of the payment coefficient indicates that the effect on utility of choosing a choice set with a higher payment level is negative. When the payment attribute is used as the normalising variable, the most important wetland management attribute is biodiversity. This is

[2] The ρ^2 value in multinomial logit models is similar to R^2 in conventional analysis, except that significance occurs at lower levels. Hensher and Johnson (1981) comment that values of ρ^2 between 0.2 and 0.4 are considered to be extremely good fits.

followed by open water surface area and research and educational opportunities, both of which are similar, and finally by the re-training of locals attribute (per person). Overall, these results indicate that positive and significant economic values exist for higher levels of ecological, economic and social attributes of the wetland. The positive and significant sign on the ASC coefficient implies that a positive utility impact occurs in any move away from the *status quo*.

[Table 3]

The CL assumes the independence of irrelevant alternatives (IIA) property, which states that the relative probabilities of two options being chosen are unaffected by introduction or removal of other alternatives. If the IIA property is violated then CL results will be biased and hence a discrete choice model that does not require the IIA property, such as random parameter logit (RPL) model, should be used. To test whether the CL model is appropriate, the Hausman and McFadden (1984) test for the IIA property is employed. The results of the test are shown in table 4 below, indicating that IIA property cannot be rejected at the 99% level. Therefore, the CL model is the appropriate model for estimation of this data.

[Table 4]

4.2. Random Parameter Logit Model

Though the CL model does not violate the IIA property, it assumes homogeneous preferences across respondents. Preferences however are in fact heterogeneous and accounting for this heterogeneity enables estimation of unbiased estimates of individual preferences and enhances the accuracy and reliability of estimates of demand, participation, marginal and total welfare (Greene, 1997). Furthermore, accounting for heterogeneity enables prescription of policies that take equity concerns into account. An understanding of who will be affected by a policy change in addition to understanding the aggregate economic value associated with such changes is necessary (Boxall and Adamowicz, 2002). The random parameter logit (RPL) model (Train, 1998), which accounts for unobserved, unconditional heterogeneity, should be used in order to account for preference heterogeneity in pure public goods (Kontoleon, 2003), such as the wetland studied in this CE.

Formally, the random utility function in the RPL model is given by:

$$U_{ij} = V(Z_j(\beta + \eta_i), S_i) + e(Z_j, S_i) \quad (4)$$

Similarly to the CL model, utility is decomposed into a deterministic component (*V*) and an error component stochastic term (*e*). Indirect utility is assumed to be a function of the choice attributes (Z_j), with parameters β, which due to preference heterogeneity may vary across respondents by a random component η_i, and of the social, economic and attitudinal characteristics (S_i), namely income, education, children, the environmentally consciousness index (ECI), whether the respondent had actually visited the wetland, and the distance from the wetland. By specifying the distribution of the error terms *e* and η, the probability of choosing *j* in each of the choice sets can be derived (Train, 1998). By accounting for unobserved heterogeneity, equation (2) now becomes:

$$P_{ij} = \frac{\exp(V(Z_j(\beta + \eta_i), S_i))}{\sum_{h \in C} \exp(V(Z_h(\beta + \eta_i), S_i))} \quad (5)$$

Since this model is not restricted by the IIA assumption, the stochastic part of utility may be correlated among alternatives and across the sequence of choices via the common influence of η_i. Treating preference parameters as random variables requires estimation by simulated maximum likelihood. Procedurally, the maximum likelihood algorithm searches for a solution by simulating *m* draws from distributions with given means and standard deviations. Probabilities are calculated by integrating the joint simulated distribution.

Recent applications of the RPL model have shown that this model is superior to the CL model in terms of overall fit and welfare estimates (Breffle and Morey, 2000; Layton and Brown, 2000; Carlsson et al., 2003; Kontoleon, 2003; Lusk et al., 2003; Morey and Rossmann, 2003).

The RPL model is estimated using LIMDEP 8.0 NLOGIT 3.0. All the parameters except the payment attribute were specified to be normally distributed (Train, 1998; Revelt and Train, 1998; Morey and Rossmann, 2003; Carlsson et al. 2003), and distribution simulations were based on 1000 draws. The results of the RPL estimations are reported in the second column of Table 3. RPL model estimates reveal significant and large derived standard deviations for the ASC and three attributes (open water surface area, research and education, and re-training) indicating that the data supports choice specific unconditional unobserved heterogeneity for these attributes and some respondents might prefer lower levels of these. The log likelihood ratio test rejects the null hypothesis that the regression parameters are equal at 0.5% significance level. Hence improvement in the model fit can be achieved with the use of the RPL model, and the RPL model is appropriate for analysis of the data set presented in this paper.

4.3. Random Parameter Logit Model with Interactions

Even if unobserved heterogeneity can be accounted for in the RPL model, the model fails to explain the *sources* of heterogeneity (Boxall and Adamowicz, 2002). One solution to detecting the sources heterogeneity while accounting for unobserved heterogeneity is by including interactions of respondent-specific social, economic and attitudinal characteristics with choice specific attributes and/or with ASC in the utility function. This enables the RPL model to pick up preference variation in terms of both unconditional taste heterogeneity (random heterogeneity) and individual characteristics (conditional heterogeneity), and hence improve model fit (e.g., Revelt and Train, 1998; Morey and Rossmann, 2003; Kontoleon, 2003).

After extensive testing of the various interactions of the four wetland management attributes with the respondents' social, economic and attitudinal characteristics collected in the survey, the model that includes education, income, having a child, ECI, distance to the wetland and whether or not the respondent had visited the wetland was found to fit the data the best. The indirect utility function is extended to include these interactions and the RPL model with interactions was estimated using LIMDEP 8.0 NLOGIT 3.0. The results are reported in the final column of Table 3. This model has a higher overall fit compared to the CL and RPL model, with a ρ^2 of 0.12. The log likelihood ratio test rejects the null hypothesis that the regression parameters for the RPL model and the RPL model with interactions are equal at 0.5% significance level, implying that improvement in the model fit is achieved with the inclusion of social, economic and attitudinal characteristics in the RPL model. Similar to the RPL model estimated above, the RPL model with interactions also results in significant derived standard deviations for the ASC and three attributes (open water surface area, research and education, and retraining) indicating that data supports choice specific unconditional unobserved heterogeneity for these attributes.

The interactions between having a university degree, and ECI and OWSA, research and education opportunities and re-training of locals, as well as the interaction between income and re-training are positive. Confirming the results of several environmental valuation studies, those respondents with higher levels of environmental consciousness, income and education are likely to prefer wetland management scenarios that provide higher levels of the ecological, social and economic wetland attributes. The positive interactions between wetland attributes and distance to the wetland are contrary to the 'decay factor' found by Bateman et al. (1995). The interaction between dummy for having visited the wetland and biodiversity and re-training are positive, indicating use value for biodiversity, and altruistic value for well-being of locals, respectively. The interaction between the dummy for having a child and biodiversity attribute is insignificant, contrary to findings of other valuation studies which have shown that having children has a positive influence on the respondents' valuation of environmental goods (e.g., Kosz 1996) due to the 'bequest motives' (Krutilla 1967).

4.4. Latent Class Model

Most recently, CE practitioners have started employing the latent class model (LCM) as an alternative model for accounting for preference heterogeneity. This model casts heterogeneity as a discrete distribution, a specification based on the concept of endogenous (or latent) preference segmentation (Bhat, 1997; Wedel and Kamakura, 2000). In LCM, the population consists of a finite and identifiable number of groups of individuals (i.e., segments), each characterised by relatively homogenous preferences. These segments, however, differ substantially in their preference structure. This approach can accommodate preference heterogeneity while allowing for the number of segments to be determined endogenously by the data. In the LCM, belonging to a segment with specific preferences is probabilistic, and depends on the social, economic and attitudinal characteristics of the respondents.

Formally, in the LCM, respondent *i* belongs to latent segment *l*, and (1) becomes:

$$U_{ij/l} = V_{ij/l}(Z_{j/l}, S_{i/l}) + e_{ij/l}(Z_{j/l}, S_{i/l}) \tag{6}$$

Again, assuming a random utility framework as the basis of a respondent's wetland management scenario choice, the probability that respondent *i* chooses wetland management scenario *j* conditional on the respondent belonging to a segment *l* takes the conditional logit form:

$$P_{ij/l} = \frac{\exp(V_{ij/l}(Z_{j/l}, S_{i/l})}{\sum_{h=1}^{C} \exp(V_{ih/l}(Z_{h/l}, S_{i/l})} \tag{7}$$

Consider a respondent's segment membership likelihood function M* that classifies respondents into one of the L latent segments. Segment membership is affected by the observed social, economic and attitudinal characteristics of the respondent (*S*). The membership likelihood function for respondents *i* and segment *l* is given by $M_{il}^{*} = \lambda_l S_i + \xi_{il}$. Assuming the error terms in the respondent membership likelihood functions are IID extreme value type I across respondents and segments, the probability that respondent *i* belongs to segment *l* can be expressed in a conditional logit form as:

$$P_l = \frac{\exp(\lambda_l S_i)}{\sum_{l=1}^{L} \exp(\lambda_l S_i)} \qquad (8)$$

where $\lambda_l \, (l = 1, 2, ...L)$ are segment-specific parameters to be estimated that denote the contribution of the various respondent characteristics to the probability of segment membership. A positive λ implies that the associated respondent characteristic, S_i, increases the probability that the respondent *i* belongs to segment *l*. P_l sums to one across the *L* latent segments, where $0 \le P_l \le 1$. The size of each segment W_l, i.e., the proportion of the sample that are predicted to belong to each segment is:

$$W_l = \frac{\sum_i P_l}{I} \qquad (9)$$

The unconditional probability that any randomly selected respondent *i* chooses alternative *j* is obtained by combining conditional probability in (7) with the segment membership probability in (8). The unconditional choice probability is a weighted average of segment-specific choice probabilities $P_{j/l}$ where the weights P_l vary systematically as a function of respondents' social, economic and attitudinal characteristics:

$$P_j = \sum_{l=1}^{L} [(P_j) * (P_{j/l})] \qquad (10)$$

In the survey presented in this paper respondents provided 8 choices and to implement the model the probability of each respondent's observed sequence of choices is required. The probability of respondent *i*'s sequence of choices over T (in this case 8) choice occasions conditional on membership in group *l* is given by:

$$P_{j_1,....,j_T/l} = \prod_{t=1}^{T} \frac{\exp(\Delta(V_{ijt/l}(Z_{jt/l}, S_{it/l})))}{\sum_{h=1}^{C} \exp(\Delta(V_{iht/l}(Z_{ht/l}, S_{it/l})))} \qquad (11)$$

The unconditional sample log-likelihood function is given by:

$$LL = \sum_{i}\sum_{j\in C} I_j \ln \sum_{l} P_l P_{j_1,\ldots,j_T/l} \qquad (12)$$

where I_j is an indicator variable for the observed choice. The unknown parameters of segment membership λ_l and choice probabilities P_l are obtained in a joint and simultaneous estimation procedure by maximising the unconditional log-likelihood of the sample over the parameter space.

The LCM, therefore assumes that respondent characteristics affect choice indirectly through their impact on segment membership. After extensive testing with the respondent characteristics that were collected in the survey, the variables that affect segment membership the most were found to be the same ones as those included in the RPL model with interactions. The LCM was estimated using LIMDEP 8.0 NLOGIT 3.0, and models with 2, 3 and 4 segments were run. The log likelihood, ρ^2, AIC and BIC statistics are reported in Table 5.

[Table 5]

Determination of the optimal numbers of segments requires a balanced assessment of the statistics reported in Table 5 (Kontoleon, 2003). The log likelihood and ρ^2 statistics improve as more segments are added, supporting the presence of multiple segments in the sample. The 2 segment solution provides the best fit to the data since, although AIC and BIC statistics decrease and ρ^2 increases as more segments are added to the model, the changes are much smaller from 2 to 3 and 3 to 4 segment models.

The results of the 2-segment model are reported in Table 6. The first part of the table displays the utility coefficients from wetland management attributes, where the second part reports segment membership coefficients. The segment membership coefficients for the second segment are normalised to zero in order to identify the remaining coefficients of the model. All other coefficients are interpreted relative to this normalised segment. For segment 1 the utility coefficients for all of the four wetland attributes are significant and segment membership coefficients reveal that higher income, ECI, distance from the wetland and having a university degree increase the probability that the respondent belongs to the first segment. For the second segment the biodiversity and research and education attributes are insignificant determinants of choice, whereas the other two attributes, i.e., OWSA and re-training of locals in environmentally friendly employment increase the likelihood that respondents in segment 2 choose a wetland management scenario with higher levels of these attributes.

[Table 6]

The relative size of each segment is estimated by inserting the estimated coefficients into equation (8). This provides the series of probabilities that each respondent belongs to either one of the two segments. The respondents are assigned to one of the segments on the basis of their largest probability score. It is found that 57.24% of the sample belongs to the first segment and 42.76% belongs to the second segment. The descriptive statistics for the social, economic and attitudinal characteristics of each segment is reported in Table 7.

[Table 7]

As expected, respondents in segment 1, who attach positive, significant and high levels of values to all four of the wetland management attributes, have statistically significantly higher levels of income, ECI, education and full time employment. A higher proportion of respondents in segment 1 have children, and they also have a higher number of dependent children in the household, revealing bequest motives. Finally, respondents in segment 1 live significantly closer to the wetland than those in segment 2, thereby revealing distance decay for valuation of this environmental resource.

Finally, LCM is compared to the RPL model with interactions by using the Ben-Akiva and Swait (1986) test for comparing for non-nested probabilistic choice models. The idea behind this test is to examine whether the systematic preference heterogeneity in this particular data set can be better explained at the individual level or at the segment level. The Ben-Akiva and Swait test rejects the null hypothesis that the RPL model with interactions is the true specification. This result may reflect the fact that the LCM provided added information that was not conveyed in the

RPL model with interactions. Even though the coefficients on respondent characteristics in the RPL model with interactions were highly significant, they are considerably less interpretable and operationally useful than those obtained for each segment under the LCM. In addition, the statistical superiority of the LCM implies that individual characteristics are affecting choice *indirectly* (through the segment membership function) rather than directly through the utility function (Kontoleon, 2003).

4.5. Estimation of Willingness To Pay

The CE method is consistent with utility maximisation and demand theory (Bateman et al. 2003), therefore when the parameter estimates are obtained by the use of the appropriate model, welfare measures can be estimated using the following formula:

$$WTP = \frac{\ln \sum_k \exp(V_k^1) - \ln \sum_k \exp(V_k^0)}{\beta_{monetaryattribute}} \qquad (13)$$

where WTP is the welfare measure, $\beta_{monetaryattribute}$ is the marginal utility of income represented by the coefficient of the monetary attribute in the CE, and V_k^0 and V_k^1 represent indirect utility functions before and after the change in wetland management. For the linear utility index the marginal value of change in a single wetland management attribute can be represented as a ratio of coefficients, reducing equation (13) to:

$$WTP = -1\left(\frac{\beta_{wetlandattribute}}{\beta_{monetaryattribute}}\right) \qquad (14)$$

This part-worth (or implicit price) formula represents the marginal rate of substitution between income and the attribute in question, i.e., the marginal WTP for a change in the attribute. Compensating surplus welfare measures can be obtained for different wetland management scenarios associated with multiple changes in attributes, i.e., equation (13) simplifies to:

$$\textit{Compensating surplus} = -(V^0 - V^1)/\beta_{monetaryattribute} \qquad (15)$$

Table 8 reports the implicit prices, or marginal WTP values, for each of the wetland management attributes estimated using the Wald procedure (Delta method) in LIMDEP 8.0 NLOGIT 3.0. For comparisons, estimates were calculated using all four models. Pair-wise t-tests of WTP estimates of each attribute reveal that the WTP estimates from the four models differ significantly at 5% significance level or less (except for the WTP for the biodiversity attribute from the CL and RPL models, and OWSA attribute from the RPL and RPL with interactions models). The ranking of attributes remains consistent for CL, RPL and RPL with interactions models, however differs for the weighted average of the two segments in LCM. This reinforces the need to use the best-fit LCM model for welfare distributional purposes since each one of models lead to different conclusions regarding the distributional impacts of benefits generated by management of wetland attributes.

[Table 8]

The implicit prices reported in Table 8 do not provide estimates of compensating surplus (CS) for the alternative management scenarios. In order to estimate the respondents' CS for improvements in wetland management over the *status quo*, three possible options were created.

- *Current scenario-Status quo:* Biodiversity is managed at a low level; open water surface area is low; research and educational opportunities is low, and no local farmers are re-trained.
- *Scenario 1- Low impact management scenario:* Biodiversity is managed at a low level; open water surface area is increased to high level; research and educational opportunities is low, and 30 local farmers are re-trained.
- *Scenario 2- Medium impact management scenario:* Biodiversity is managed at a high level; open water surface area is low; research and educational opportunities is high, and 75 local farmers are re-trained.

- *Scenario 3- High impact management scenario:* Biodiversity is managed at a high level; open water surface area is high; research and educational opportunities is high, and 150 local farmers are re-trained.

To find the CS associated with each of the above scenarios the difference between the welfare measures under the *status quo* and the three management scenarios are calculated. Note that in order to estimate overall WTP for wetland management it is necessary to include the ASC, which captures the systematic but unobserved information about respondents' choices. The estimates of WTP for the three scenarios are reported in Table 9 below. For comparisons, CS estimates are calculated for all four models.

[Table 9]

As expected, the CS for the change from the *status quo* to the scenarios considered increases as we move towards improved ecological, social and economic conditions in the wetland. For the best-fit LCM the mean WTP for the *Low impact scenario* is €107.56, whereas greater improvements in ecological, social and economic conditions in the wetland under the *Medium impact scenario* increases mean WTP to €116.49, and under the *High impact scenario* to as high as €134.46.

4.6 Cost Benefit Analysis

The results can be used to design socially efficient wetland management policies by estimating the cost of improving the different attributes of the wetland and by comparing these to the benefits they generate (Carlsson et al., 2003). The cost estimates for improvements in the different attributes are reported in Table 10. The total cost of providing the *Low impact scenario* is

€500,872 per annum; the total cost of providing the *Medium impact scenario* is €6,314,179 per annum; and the total cost of providing the *High impact scenario* is €7,021,358 per annum [3].

[Table 10]

Further, the welfare estimates reported in Table 9 for the weighted LCM are aggregated over the entire sampling frame to determine the total WTP (i.e., total benefits) for the three scenarios described above. Based on the fraction of the sample agreed to take part in the survey (58%), the aggregate WTP to achieve the ecological and social conditions described in the *Low impact scenario* is €335,852,335; in the *Medium impact scenario* the aggregate WTP is €363,735,948; and for the *High impact scenario*, this amounts to €419,846,644. The aggregate benefits are therefore significantly higher than the total costs of each scenario. More specifically, the aggregate net benefits from the *Low impact scenario* is €335,351,463; €357,421,769 for the *Medium impact scenario* and €412,825,286 for the *High impact scenario*. Thus, the total net economic benefits of wetland management increase in the impact of the management scenario. However, it should be noted that the benefit estimates are likely to be upwards biased due to hypothetical nature of the payment commitment (i.e., hypothetical bias). Therefore the net benefits generated by the alternative management scenarios should be considered as upper bound values.

5. Policy Implications and Conclusions

This paper contributes to the limited literature on estimation of economic values of wetlands using choice experiments, and is one of the few wetland valuation studies that has been undertaken in

[3] To estimate the annual profit loss per farmer, the following data was used: Total area of cultivated land, (L): 6250 ha; Total number of farmers, (F): 1470; Average land per farmer (L/F): 4.25 ha. Therefore, average annual profit loss per farmer is 6762.39 (4.25 x 1591.15). Thus for example, the total cost of the high impact scenario is calculated as: [Biodiversity high (4,000,000 + 1,000,000 + 25,000) + OWSA high (200,000) + Research and Education Opportunities high (600,000 + 84,000) + Re-training 150 farmers (98,000 + (6762.39x150))] = €7,021,358 for the first year.

Greece. The results indicate that there are positive and significant economic benefits associated with ecological, economic, and social attributes of the Cheimaditida wetland. The impacts of social, economic and attitudinal characteristics of respondents on their valuation of wetland management attributes are significant and conform with economic theory. Further, there is considerable preference heterogeneity within the Greek public, which should be taken into consideration when designing provision of public goods, such as wetlands.

The total benefits derived from various wetland management scenarios are aggregated over the sampling frame, and compared to their costs. The net benefit estimates reveal that social welfare maximisation is achieved under the ***High impact scenario*** of wetland management, which provides higher levels of ecological, social and economic attributes. With the use of the benefits transfer method, this study is expected to provide policy-makers with useful information for management of other similar wetlands in Greece, as well as in Europe, given the current mandate under the European Union's Water Framework Directive and the obligations of the Ramsar Conventions.

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8. Tables

Table 1. Wetland management attributes and levels used in the CE

Attribute	Definition	Management levels
Biodiversity	The number of different species of plants, animals, their population levels, the number of different habitats and their size.	Low: Deterioration from current levels High: A 10% increase in population and size of habitats
Open water surface area (OWSA)	The surface area of the lake that remains uncovered by reed beds.	Low: Decrease from the current open water surface area of 20% High: Increase open water surface area to 60%
Research & education	The educational, research and cultural information that may be derived from the existence of the wetland, including visits by scientists, students, and school children to learn about ecology and nature.	Low: Deterioration from the current levels of opportunities High: Improve the level of educational and research opportunities by providing better facilities
Re-training of farmers	Re-training of local farmers in environmentally friendly employment such as eco-tourism and arid-crop production.	Number of farmers re-trained in environmentally friendly employment: 30, 50, 75, 150
Payment	A one-off payment to go to the 'Cheimaditida Wetland Management Fund'.	4 payment levels from the pilot CV: € 3, €10, €40, €80

Table 2. Social, economic and attitudinal characteristics of the respondents

Variable	Sample average[a]	Greek average[b]
Heard of the wetland (%heard)	32.7%	-
Visited the wetland (%visited)	19.5%	-
Environmentally consciousness index (ECI) (1-20)	5.3 (3.6)	-
Gender (% female)	49.9%	50.5%
Age	39.2 (14.7)	40.2[c]
Household size	3.2 (1.3)	3.5
Children (% with children)***	51.2%	68%
Number of dependent children in the household	0.8 (0.9)	1.1
Education (% with university degree and above)***	54.3%	18%
Employment (% with full time employment)***	57.6%	46.7%
Tenure (% own property)	78.2%	80%
Income (net, in € per month)***	1850.6 (1198.4)	1358
Distance from the wetland (in km)	204.2 (194.4)	-
Urban (% located in Athens and Thessaloniki)	46.4%	58%
Sample size, N	407	10,628,113

[a] Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005; [b]Source: National Statistical Service of Greece (NSSG) (2003) www.statistics.gr [c]Median age; T-tests and Pearson Chi square tests show significant differences (*) at 10% significance level; (**) at 5% significance level, and (***) at 1% significance level.

Table 3. CL, RPL and RPL with interactions estimates for wetland management attributes

	CL Model	RPL Model		RPL Model with Interactions	
Attributes and interactions	Coefficient (s.e.)	Coefficient (s.e.)	Coeff. Std. (s.e.)	Coefficient (s.e.)	Coeff. Std. (s.e.)
ASC	0.784***	1.748***	2.30***	1.22***	0.098
	(0.064)	(0.509)	(0.88)	(0.157)	(0.58)
Biodiversity	0.222***	0.325***	0.069	0.13	0.012
	(0.025)	(0.065)	(0.258)	(0.11)	(0.33)
OWSA	0.140***	0.227***	0.707***	-0.08	0.81***
	(0.027)	(0.064)	(0.262)	(0.13)	(0.19)
Research & education	0.124***	0.195***	0.462*	0.18*	0.79**
	(0.026)	(0.055)	(0.335)	(0.13)	(0.2)
Re-training	0.002***	0.003***	0.012***	-0.2***	0.016***
	(0.001)	(0.001)	(0.005)	(0.004)	(0.003)
Payment	-0.014***	-0.021***	-	-0.23***	-
	(0.001)	(0.004)		(0.028)	
Biodiversity*Education	-	-	-	0.055	-
				(0.082)	
OWSA*Education	-	-	-	0.13*	-
				(0.099)	
Research*Education	-	-	-	0.15*	-
				(0.096)	
Re-training*Education	-	-	-	0.006***	-
				(0.002)	
Biodiversity*ECI	-	-	-	-0.0015	-
				(0.011)	

OWSA*ECI	-	-	-	0.051**	-
				(0.014)	
Research*ECI	-	-	-	0.033**	-
				(0.013)	
Re-training*ECI	-	-	-	0.002***	-
				(0.0003)	
Biodiversity*Income	-	-	-	$0.1x10^{-4}$	-
				($0.3x10^{-4}$)	
OWSA*Income	-	-	-	$-0.3x10^{-4}$	-
				($0.4x10^{-4}$)	
Research*Income	-	-	-	$0.1x10^{-4}$	-
				($0.4x10^{-4}$)	
Re-training*Income	-	-	-	$0.3x10^{-5}$**	-
				($0.8x10^{-6}$	
Biodiversity*Child	-	-	-	0.05	-
				(0.08)	
OWSA*Child	-	-	-	-0.2**	-
				(0.1)	
Research*Child	-	-	-	-0.04	-
				(0.09)	
Re-training*Child	-	-	-	-0.004**	-
				(0.002)	
Biodiversity*Visit	-	-	-	0.14*	-
				(0.1)	
OWSA*Visit	-	-	-	-0.07	-
				(0.12)	

Research*Visit	-	-	-	-0.1	-
				(0.1)	
Re-training*Visit	-	-	-	0.005**	-
				(0.002)	
Biodiversity*Distance	-	-	-	0.0006***	-
				(0.0002)	
OWSA*Distance	-	-	-	0.0009***	-
				(0.0003)	
Research*Distance	-	-	-	0.001***	-
				(0.0003)	
Re-training*Distance	-	-	-	$0.4\text{x}10^{-4}$***	-
				($0.6\text{x}10^{-5}$)	
Log likelihood	-3325.697	-3316.284		2485.16	
ρ^2	0.0703	0.0729		0.1191	
Sample size	3256	3256		3256	

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005.

*** 1% significance level, ** 5% significance level, *10% significance level with two-tailed tests

Table 4. Test of Independence of Irrelevant Alternatives

Alternative dropped	χ^2	D.o.f.	Probability
Scenario A	23.36	5	0.0003
Scenario B	54.92	5	0.0000
Scenario C	93.05	5	0.0000

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005

Table 5. Criteria for Determining the Optimal Number of Segments

No. of Segments	Log likelihood	ρ^2	Parameters (P)	AIC	BIC
1	-3325.7	0.07	6	6663.4	3301.44
2	-2538.98	0.29	18	5041.96	2611.50
3	-2428.2	0.321	30	4916.4	2306.88
4	-2423.8	0.322	42	4931.6	2253.95

AIC(Akaike Information Crietrion) is –2(LL-P); BIC(Bayesian Information Criterion) is –LL+(P/2)*ln(N)

Table 6. Two Segment LCM estimates for wetland management attributes

	Segment 1	Segment 2
Utility function: Wetland management scenario attributes		
ASC	2.4*** (0.095)	-1.19*** (0.17)
Biodiversity	0.27*** (0.026)	0.08 (0.08)
OWSA	0.16*** (0.028)	0.29*** (0.085)
Research & education	0.14*** (0.027)	-0.08 (0.08)
Re-training	0.003*** (0.0007)	0.003** (0.0019)
Payment	-0.015*** (0.001)	-0.042*** (0.005)
Segment function: Respondents' social and economic characteristics		
Constant	-0.38 (0.37)	
Education	0.44** (0.25)	
ECI	0.06* (0.035)	
Income	0.0002** (0.0001)	
Child	0.25 (0.27)	
Visit	0.005 (0.3)	
Distance	0.004*** (0.001)	
Log likelihood	2538.98	
ρ^2	0.29	
Sample size	3256	

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005.

*** 1% significance level, ** 5% significance level, *10% significance level with two-tailed tests

Table 7. Profiles of respondents belonging to the two segments in LCM

Social and economic characteristics	Segment 1 N=233	Segment 2 N=174
Heard of the wetland	30.6%	31.2%
Visited the wetland**	13.7%	21.2%
ECI***	7 (3.5)	4.3 (3.2)
Gender***	61.5%	43.3%
Age	38.9 (13.4)	40.2 (15.3)
Household size***	3.6 (1)	2.9 (1.3)
Children***	67.6%	45%
Number of dependents***	1.2 (0.9)	0.6 (0.9)
Education***	88%	32.9%
Employment***	66.4%	57%
Tenure	80%	80.3%
Income***	2701.5 (1319.5)	1470.7 (735.2)
Distance **	193.1 (165.8)	241.2 (225.3)
Urban*	51.8%	46.3%

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005; T-tests and Pearson Chi square tests show significant differences (*) at 10% significance level; (**) at 5% significance level, and (***) at 1% significance level.

Table 8. Marginal WTP for wetland management attributes (€ / respondent) and 95% C.I.

Attributes	CL Model	RPL Model	RPL Model Interactions	Latent Class Model		
				Seg. 1	Seg. 2	Weighted
Biodiversity***	15.62	15.44	15.10	17.8	-	7.7
	(13.55-17.69)	(13.57-17.3)	(13.10-17.10)	(16.10-19.5)		(6.96-8.44)
OWSA***	9.86	10.79	11.02	10.01	7.25	8.45
	(7.90-11.82)	(8.80-12.78)	(8.94-13.10)	(8.25-11.88)	(5.13-9.38)	(6.48-10.46)
Research &	8.69	9.27	10.79	9.1	-	3.93
education***	(6.80-10.58)	(7.45-11.09)	(8.76-12.82)	(7.34-10.84)		(3.17-6.15)
Re-training	0.122	0.129	0.154	0.195	0.075	0.127
(per person)***	(0.078-0.166)	(0.078-0.18)	(0.103-0.210)	(0.149-0.24)	(0.03-0.12)	(0.066-0.172)

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005. T-tests show significant differences among at least one pair of models (*) at 10% significance level; (**) at 5% significance level, and (***) at 1% significance level.

Table 9. Compensating Surplus for each scenario (€ / respondent)

Scenario	CL Model	RPL Model	RPL Model with Interactions	Latent Class Model		
				Seg.1	Seg.2	Weighted
1- Low impact	83.77	62.24	58.2	170	57.75	107.59
2- Medium impact	103.71	81.87	80.11	195.67	53.88	116.49
3- High impact	122.72	120.43	102.69	220.3	66.75	134.46

Source: Cheimaditida Wetland Management Choice Experiment Survey, 2005. T-tests show significant differences (*) at 10% significance level; (**) at 5% significance level, and (***) at 1% significance level.

Table 10. Cost estimates for improvement in wetland management

Management Intervention	Cost in € (2005)[a]
Biodiversity:	
1. Improve water quantity by switching to water-saving irrigation technologies and construction of a dyke	4,000,000
2. Improve water quality with construction of waste water treatment plant	1,000,000
3. Protection, conservation, and restoration of Priority Natural Habitats (92/43/EEC)	25,000
Increase OWSA:	
Open and maintain corridors in the reed bed	200,000
Research and Education Opportunities:	
1. Construction of a visitor centre	600,000
2. Monthly two-day researcher's bench (collect data/samples, sort and browse)	84,000 /annum
Retraining Farmers:	
1. Two seminars of 100 hrs for beginners, theory and practice	98,000
2. Cost (i.e., farmers profit loss) of switching to non-irrigated crops[b]	1591.2 /ha/annum

Source: Miltos Seferlis, personal communication (EKBY, 2005);[a] These are one-time costs, unless otherwise indicated;[b] This is the difference between gross margin for non-irrigated crops (76.63 €/ha/annum), and gross margin for irrigated crops (1667.78 €/ha/annum).

9. Figure captions

Figure 1. Sample choice set

<table>
<tr><td colspan="4">Which of the following wetland management scenarios do you favour? Option A and option B would entail a cost to your household. No payment would be required for “Neither management scenario” option, but the conditions at the wetland would deteriorate to low levels for biodiversity, open water surface area and research and education attributes, and no locals would be re-trained.</td></tr>
<tr><td></td><td>Wetland management Scenario A</td><td>Wetland management Scenario B</td><td rowspan="6">Neither management scenario A nor management scenario B:

I prefer NO wetland management</td></tr>
<tr><td>Biodiversity</td><td>Low</td><td>High</td></tr>
<tr><td>Open water surface area</td><td>Low</td><td>Low</td></tr>
<tr><td>Research and education</td><td>High</td><td>Low</td></tr>
<tr><td>Re-training of locals</td><td>50</td><td>50</td></tr>
<tr><td>One-off payment</td><td>€ 3</td><td>€ 10</td></tr>
<tr><td>I would prefer:
(Please tick as appropriate)</td><td>Choice A</td><td>Choice B</td><td>Neither</td></tr>
</table>