Assessment of social demand for environmental and cultural heritage preservation: evidence from a discrete choice experiment in Tunisia

Missaoui, Sameh; Rahmani, Djamel; Thabet, Chokri; Feás, Jacobo; Gíl, José María; Akaichi, Faical

Published in:
Frontiers in Environmental Economics

DOI:
10.3389/frevc.2023.1234249

First published: 03/10/2023

Document Version
Publisher's PDF, also known as Version of record

frontiers | Frontiers in Environmental Economics

TYPE Original Research
PUBLISHED 03 October 2023
DOI 10.3389/frevc.2023.1234249

OPEN ACCESS

EDITED BY
Aroon Parshotam,
Cleanwaters NZ Ltd., New Zealand

REVIEWED BY
Samir Sayadi,
Andalusian Institute for Research and Training in Agriculture, Fisheries, Food and Ecological Production (IFAPA), Spain
José Luis CruZ,
Instituto Madrileño de Investigación y Desarrollo Rural, Agrario y Alimentario, Spain

*CORRESPONDENCE
Sameh Missaoui
✉ sameh.missaoui@upc.edu

RECEIVED 03 June 2023
ACCEPTED 29 August 2023
PUBLISHED 03 October 2023

CITATION
Missaoui S, Rahmani D, Thabet C, Feás J, Gíl JM and Akaichi F (2023) Assessment of social demand for environmental and cultural heritage preservation: evidence from a discrete choice experiment in Tunisia.
Front. Environ. Econ. 2:1234249.
doi: 10.3389/frevc.2023.1234249

Assessment of social demand for environmental and cultural heritage preservation: evidence from a discrete choice experiment in Tunisia

Sameh Missaoui[1,2]*, Djamel Rahmani[1], Chokri Thabet[2], Jacobo Feás[3], José María Gíl[1] and Faical Akaichi[4]

[1]Centro de Recerca en Economia i Desenvolupament Agroalimentari (CREDA), Universidad Politécnica de Cataluña (UPC), Parc Mediterrani de la Tecnologia, Barcelona, Spain, [2]Higher Institute of Agriculture of Chott Mariem, University of Sousse, Sousse, Tunisia, [3]Facultade de Administración e Dirección de Empresas - USC, Universidade de Santiago de Compostela, Lugo, Spain, [4]Scotland's Rural College (SRUC), Scotland, United Kingdom

Weighing cultural legacies is crucial to better understand the opportunity costs of lagoon restoration. It may be necessary for local populations whose wellbeing and culture are closely linked to heritage. This paper investigates the preferences and willingness to pay (WTP) of local fishermen for contributing to the restoration of the Bizerte lagoon (Tunisia, North Africa) and the management of the *Manzel Abderrahmen* harbor through the implementation of the *EcoPact* project. For this purpose, a discrete choice experiment (DCE) survey was conducted in the port with 50 local fishers. The results of this work represent a particular contribution to the literature as they offer a different perspective on the willingness to pay for the benefits of Cultural Bequest. *Manzel Abderrahmen* fishermen view "port organization" as an economic, cultural, and recreational attribute that drives their choices. The fishermen showed their willingness to accept all the taxes mentioned in the questionnaire and to increase the actual tax (9%) up to 13% over 5 years to complete the design of their port. This suggests that decision-makers should be aware of the omitted legacy values that could influence subsequent decision-making.

KEYWORDS

fishers' preferences, willingness to pay, choice experiment, port cultural legacies, lagoon restoration

1. Introduction

The economic values of ecosystem services must be assigned once people understand how needs and wants are affected by changes in those services (Doherty et al., 2014). Marine ecosystems also provide a variety of ecological benefits that can be directly or indirectly converted into economic goods and services for humans (Remoundou et al., 2015); for example, lagoons provide protein, raw materials, natural heritage, and tourism recreation (Martínez-Paz et al., 2013). So, avoiding its degradation needs concrete answers based on socio-ecological economics (Molinos-Senante et al., 2012). Recent investigations are giving more and more importance to cultural legacies when assessing ecosystem services. In another word, weighing cultural legacies is crucial to better understand the opportunity costs of lagoon restoration. It may be necessary for local populations whose wellbeing and culture are closely linked to heritage.

As defined by Millennium Ecosystem Services [Millennium Ecosystem Assessment (Program, MES), 2005], cultural heritage refers to "a particular building or structure, archaeological site, natural landscape" from which people can derive "spiritual enrichment, cognitive development..." and cultural significance. Since then, many studies have recently highlighted that cultural heritage has a direct impact on both social and local economic activities (Legg et al., 2020), and if there are no public interventions, there is a high potential risk of "disappearance" (Durán et al., 2015). Cheng et al. (2019) reported that ecosystem service (ES) benefits are linked to bequest and aesthetic values. However, the cultural values of the legacy associated with these ecosystems remain hardly explored in the literature (Wright and Eppink, 2016). For example, in the case of marine and maritime ecosystems, trade-offs that incorporate cultural legacy values provide an essential lever to understand the opportunity costs of lagoon restoration better and may be relevant to local populations whose wellbeing and culture are closely linked to heritage (Oleson et al., 2015).

In this context, the fishing communities of Bizerte (North of Tunisia), more specifically those of *Manzel Abderrahmen*, develop a unique relationship with their port and the lagoon. For fishers, the port and the lagoon do not represent only numbers related to production and incomes. Rather, they are *"a cultural and historical heritage that they inherited from their ancestors and that represents a status in both economies from which they derive their income and heritage, which creates in them a sense of belonging and a desire to preserve it for fear of losing it,"* according to the president of the Fishermen's Guild. Consequently, it is an essential part of the fishermen's identity formation and history (Durán et al., 2015).

Both the lagoon and the port of *Manzel Abderrahmen* are characterized by contributing to Tunisia's GDP (income from fish and aquaculture) and providing protein derived from fish products. Therefore, the lagoon is vulnerable to pollution from human activities, including industrialization, agriculture and climate change. This vulnerability is reflected in the input of many types of organic, inorganic, and nutrient pollutants that, when in excess, especially nitrate and phosphate, lead to eutrophication of marine ecosystems (Owa, 2014).

According to our review of the existing literature in Bizerte, no study has attempted to assess the socio-economic losses of fishermen (food safety and food security of local fishing communities) in the Bizerte lagoon due to pollution and to appreciate the cultural heritage values associated with the port. Therefore, it is crucial to investigate the fishermen's perception on their port and lagoon. Thus, to achieve the objectives of the present research, we conducted a discrete choice experiment (DCE) with subsample of 50 fishermen from a total population of 147[1] fishermen (APIP,[2] 2020) in *Manzel Abderrahmen* port from October to November 2021.

The results of this work are a particular contribution to the literature as they offer a different perspective on the willingness to pay for cultural heritage benefits in a developing country in northern Africa and how CES can influence their intentions to support the public environmental restoration of the projects. This paper addresses these questions, analyzing the local fishing community's preferences and willingness to pay to enhance their wellbeing through their lagoon and port using a Discrete Choice Experiment (DCE). This study aims to (i) assess fishermen's willingness to contribute to the improvement of the lagoon through the implementation of the *EcoPact* project.[3]; (ii) assess fishermen's demand for legacy services provided by their port; (iii) measure how a heritage attribute can influence the WTP and the importance of being included in economic valuations; (iv) provide policymakers with a clear vision for a better implementation of the *EcoPact* project and be aware of omitted legacy values that could influence subsequent decision making.

To achieve the objectives of the present study we made and tried to answer the following questions:

- Is the port organization more critical to fishers than biodiversity? (Q1)
- Are taxes limiting factors of fishers' willingness to pay? (Q2)
- Are fishers sensitive to the tax, or whatever the tax to pay, they will opt to improve the actual situation (production, biodiversity, port organization and water quality)? (Q3)
- Have fishers environmentally friendly beliefs? (Q4)

This paper is organized as follows. The next section presents our methodology to determine social willingness to participate in improving port management and lagoon restoration. Section 3 reports the most relevant results and the key findings of this research. The final section provides a list of key discussions and recommendations for policymakers.

2. Methods

2.1. Studied area

The present study is situated in Bizerte lagoon, located in northern Tunisia, which covers an area of about 150 km^2. This watershed is connected to the Mediterranean Sea by an 8.5 km long straight channel and to Lake Ichkeul (110 km^2) by Tinja stream (Agbekpornu et al., 2014), as shown in Figure 1. These studied streams are bounded by industrial, urban, domestic, and agricultural effluents (Toumi et al., 2019). Bizerte lagoon[4] represents one of the most productive poles in the north of Tunisia

1 *This number represents fishers already having a license to fish in the lagoon (indigenous); clandestine fishermen are not included.*

2 *Declared by APIP : Agence des Ports et des Installations de Pêche, Tunisia.*

3 *Tunisian authorities under the frame of Euro-Mediterranean implemented the EcoPact project to enhance the lagoon's socio-economic and environmental situation. Its actions are mainly based on the reduction of industrial pollution, in particular Atmospheric emissions, liquid effluents, and solid waste and the collection and treatment of wastewater following Tunisian standards by implementing a pilot individual sanitation system for scattered dwellings in rural areas and modernizing three of wastewater treatment plants in Bizerte, Manzel-Bourguiba and Mateur in industrial zones. Another action is dedicated to extending the artisanal port Menzel Abderrahmèn in order to reduce exposure to storms and increase its boat accommodation capacity and develop an esplanade to the east of Menzel Abderrahmèn port to improve the lagoon frontage of the region. The EcoPact program link: http://ecopactbizerte.org*

as it contributes to the country's GDP through fishery products, aquaculture, shellfish farming and industrial activities [Direction Générale de la Pêche et d'Aquaculture (DGPA), 2020]. However, even that, the region is nowadays suffering consequences of the misuse of the lagoon.

Since 1960, numerous industries have been located near this lagoon. Nutrients and toxic compounds from these industries, agricultural and domestic sources, and untreated sewage cause severe water quality degradation problems, invasive species, and eutrophication (Ben Garali et al., 2011). These different pollution sources also negatively impact fisheries (Nunes et al., 2015). As a result, much of the literature on the Bizerte lagoon has focused on highlighting the primary nutrients and multiple contaminants resulting from pollution (Béjaoui et al., 2008; Ben Salem et al., 2017, 2019) and assessing their impact on the mechanisms and characteristics of the lagoon, especially on severe environmental and anthropogenic changes (Afli et al., 2009; Toumi et al., 2019).

As for the port, it is located inside the Bizerte lagoon, 5 km from *Manzel Jemil* and 4 km from Bizerte [Direction Générale de la Pêche et d'Aquaculture (DGPA), 2020], as it is shown in Figure 2. This port was built in 1968 and was the subject of an extension works partially completed in 1995, and its design is planned to be completed through the project.

Within the framework of the Euro-Mediterranean, Tunisian authorities implemented the *EcoPact*[5] program to restore the region's environmental and socio-economic situation. The decontamination of the lagoon and the extension of the port of *Manzel Abderrahmen are* two of the main objectives of this program.

According to the *Statistical*[6] *yearbook of the Tunisian Ministry of Agriculture published by Observatoire National de l'Agriculture (ONAGRI) (2020)*, the port of *Manzel Abderrahmen*[7] represents one of the most productive ports in Bizerte. It contributes up to 38% to Bizerte's fishery and shellfish farming sectors. This production decreased by about 40% between 2008 and 2019 (from 169 tones in 2008 to 67 tones in 2019) [Direction Générale de la Pêche et d'Aquaculture (DGPA), 2018]. This decrease in production is mainly due to the decline in fishery stock products in the lagoon and the extinction of certain species as a result of the high level of pollution of this lagoon (e.g., an increase in water temperature, an increase of dissolved oxygen rate, presence of nutrients and heavy metals, wild-harmful algae, a change in the biochemical composition of water, and change in the quality of water) (Barhoumi, 2014).

In this context, the values of wetland and marine ecosystem restoration have been largely discussed through economic valuations (Birol et al., 2006; Wattage and Mardle, 2008; Beharry-Borg and Scarpa, 2010; Wang et al., 2013; Tan et al., 2018; Duijndam et al., 2020). In the case of fishers, several studies have used the choice experiment method to carry out the willingness to pay of fishers worldwide and to value the damage caused by pollution around marine ecosystems. For instance, Agbekpornu et al. (2014) elicited the willingness to pay of artisanal fisheries in Ghana to participate in an insurance scheme of certain risks (Health insurance, Motor vehicle…). Goncuoglu Bodur et al. (2017) analyzed the sustainable use of fisheries in the Lake of Marmara, Turkey. Mulatu et al. (2018) carried out a choice experiment to analyze the preferences of the fishing community for an ecosystem-based fisheries management alternative' for Lake Naivasha, located in Kenya. Smyth et al. (2009), Agimass and Mekonnen (2011), Perni et al. (2011), and Lee et al. (2014) used a Discrete choice Experiment study (DCE) to determine fishermen's preferences for changes in ecological wellbeing.

Regarding the assessment of fishers' social demand for cultural heritage and because of the low availability of data for cultural ecosystem services (CES) assessments, researchers have been investigating evaluation methods of CES for decades, and many studies were dedicated to assessing bequest values related to marine ecosystems. For example, Oleson et al. (2015) conducted a meta-analysis to highlight different methods that can be used to evaluate CES. The reliability and validity of economic valuation studies related to cultural heritage can be criticized because values may vary from one place to another and depend on the valuation methods used.

2.2. Designing the survey and the choice experiment

This study is largely based on a recent preference study guide published by Johnston et al. (2017), which derives best practice recommendations for a successful preference study. We assessed fishermen' interest in supporting public environmental projects to improve their wellbeing by combining two research methods: qualitative (deep interviews and focus groups) and quantitative (surveys) methods.

2.1.1. Interviews

Interviews were conducted with stakeholders, including citizens, factories, fishermen, administrations and associations, to get their perspective on the situation in Bizerte and better understand the lagoon's state. For this purpose, several visits (December 2019–January 2020) were carried out, and each stakeholder was asked verbatim questions to identify the populations most affected by the pollution and their expectations from the project. Questions were focused on their environmental attitudes toward the situation of the lagoon (transparency/color of water, gas emissions from industries, smell, visibility) and their social perception of the lagoon itself (what it represents to them?).

4 *This lagoon contributes in 5.15% in the total national production with 6.14% as production value. According to the Direction Générale de la Pêche et d'Aquaculture (DGPA) (2018), the most species are: Eel, Solea, Lichia amia, Seriola dumerlii, Dicentrarchus labrax, Mugil Cephalus.*

5 *The EcoPact program link: http://ecopactbizerte.org*

6 http://www.onagri.nat.tn/statistiques

7 *Bizerte Fishery production is obtained from eight ports and harbors of landing; the productive ones are Bizerte Port, Cap Zbib Port, Ghar el Melh Port, and Menzel Abderrahmen Port (DGPA, ONAGRI, Statistical yearbook, 2022).*

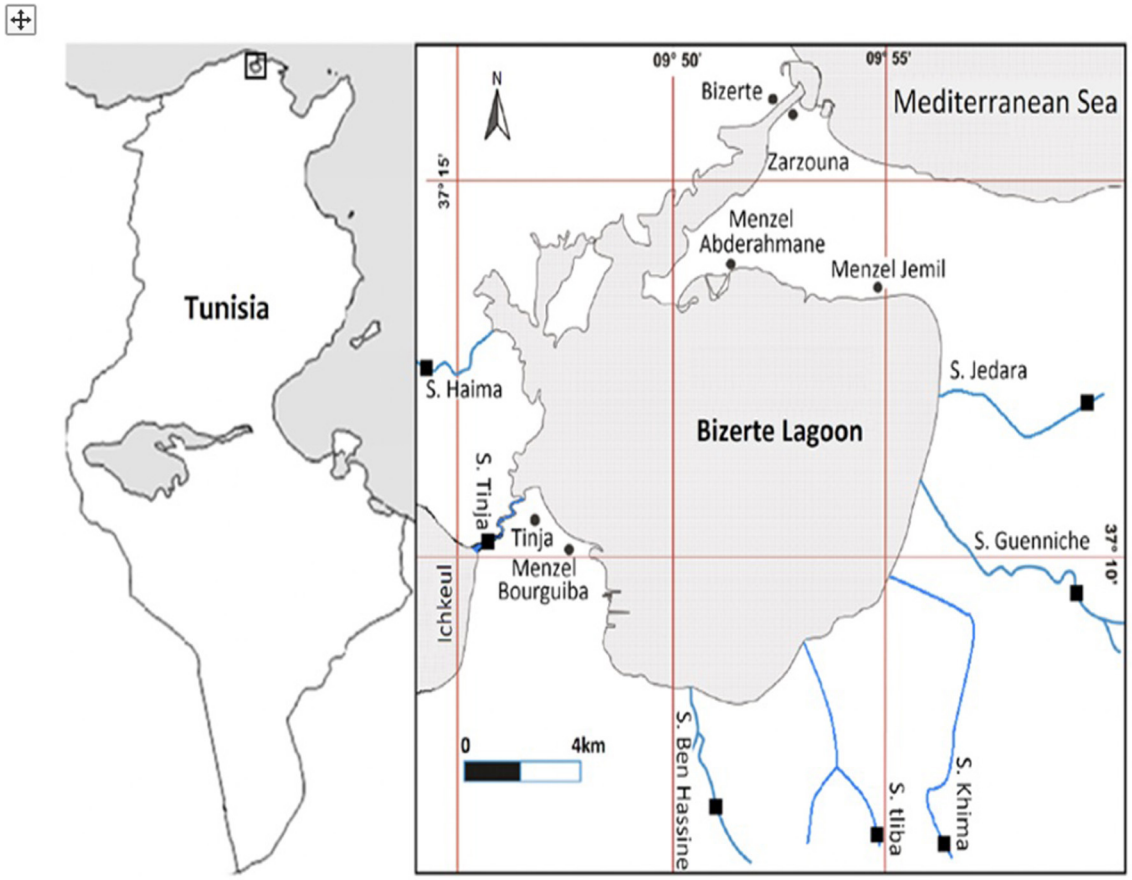


FIGURE 1
Geographic localization of Bizerte lagoon (Source: Toumi et al., 2019).

FIGURE 2
Manzel Abderrahmèn "ports" geographic localization [Source: Direction Générale de la Pêche et d'Aquaculture (DGPA), 2018].

2.1.2. Survey

The data were collected using a choice experiment-based survey. The survey consisted of a discrete choice task and a questionnaire. Respondents were successively provided 12 choice cards in the discrete choice task. Each choice card included three different alternatives. The first two alternatives showed the harbor and the lagoon with different levels of improvement, and the third alternative represented the "Status quo" alternative. All the alternatives (including the status quo) were described and displayed in a precise, understandable, and interpretable form to

ensure bias-free estimation. Respondents were informed about the questionnaire's objective and that their responses would be anonymized. They were asked to state their preferences for one of the alternatives presented in each choice set.

The questionnaire consisted of three sections. The first section was used to collect information about respondents' socio-demographic characteristics such as age, origin, number of people under their control, production/day, household income and education level. The second section asked for information about the working conditions in the port. We also collected information on fishermen's perceptions of the current situation (environmental status and port organization), whether they have noticed a decrease in fishery production and types of fishery products, and whether they have heard about the restoration of the lagoon and the implementation of the *EcoPact*. The third section is designed to collect information on fishermen's attitudes toward the environment and their confidence in the government's decisions to improve their situation. The last section of the survey was dedicated to the DCE.

2.1.3. Survey development and implementation

The design of this questionnaire was based on an extensive research based on a literature review and the opinions of experts and stakeholders in the face-to-face interviews. Stakeholders, mainly fishermen, were asked to comment on a list of benefits the project would bring. Based on these data and existing literature, we selected the most essential benefits to use as attributes in our survey.

Each target interviewee was debriefed about the questionnaire's conception and objective with a verbatim explanation of each question. They were also informed that this questionnaire will be anonymous and that they will never be individually identifiable.

In order to prepare fishermen for the face-to-face survey, regional delegates for fishing contributed to the diffusion of the survey. We described the questionnaire using a language that is understandable and accurate to respondents. In other words, the survey was written in French and explained to fishermen in the current Arabic language to better understand it, especially for those without an education level.

Face-to-face surveys were conducted with 50 fishermen from October to November 2021 to elicit *Manzel Abderrahmen* fishers' preferences for the port extension and Bizerte lagoon restoration. According to Reed Johnson et al. (2013), face-to-face surveys tend to facilitate the baseline conditions, the mechanism of changes and the change itself; the interviewer can control the questions and use visual aids.

2.1.4. Experimental design and choice task development

The alternatives presented in the choice task are described in terms of five attributes: two environmental attributes (biodiversity and water quality) and three social attributes (annual fisheries production, port organization, and taxes) to reflect the benefits that may accrue if the lagoon is restored and the port organization is improved, and the additional cost that fishermen may incur to get those benefits.

Four attributes (annual production, biodiversity, water quality and taxes) have four levels each, and the attribute port organization has two levels. See Table 1 for a description of the attributes' levels. Given all the attributes' levels, a full factorial design of 512 alternatives can be generated. Since using the full factorial design would be time-consuming and cognitively challenging for respondents, a partial factorial design was used. In particular, a D-efficient design of 12 choice sets was generated using the software Ngene.

In each choice set, fishermen were asked to choose between three alternatives: two program modalities and status quo. Each program modality represents a level of improvement over the current situation (i.e., the status quo). The status quo alternative was added to the choice set to make the DCE more realistic. The selection of these attributes was primarily justified based on existing literature on fishermen's and citizens' willingness to pay for remediation of marine ecosystem pollution damage, as well as on a qualitative information collected via a focus group with stakeholders and face to face interviews with seven fishermen conducted 2 weeks (in October 2021) before the final version of the survey was prepared.

According to the focus group, port management and organization are key attributes. This attribute was represented by two designs downloaded from the project's plausibility study to help fishermen understand the final management of the port (PORT1, PORT2). The two designs have one thing in common: the tail of the port (east side) will be completed, but they differ in the area devoted to port services such as toilets, installation of the police office, and fishing guard. We suspected this attribute was essential to them because the harbor represented a sense of belonging. Therefore, according to Durán et al. (2015), analyzing the impact of preserving maritime and fishing heritage in this region may allow a better understanding of the interaction between social wellbeing and economic maritime activities.

We initially attempted to apply these imprecise levels of "High, Medium, and Low" to each attribute unless they were unique and readily identifiable. However, after a pretest, we proceeded to establish other levels that could make the consequences of benefits to fishermen more explicit. We also learned from the information collected during the pretest that fishermen's willingness to pay also depends on the water quality of the lagoon (defined as from low to high): Water_1 (reference level), Water_2, Water_3, Water_4) and biodiversity (BIODIV_1 (reference level), BIODIV_2, BIODIV_3, BIODIV_4). In this context, Birol et al. (2006) and Tan et al. (2018) used water quality and biodiversity to assess respondents' willingness to pay for sustainable wetland management. Water quality is scaled by the degree of water clarity and transparency, while biodiversity is scaled by the degree of species diversity of fish, algae, and marine plants. The fourth attribute is the total annual production of fishery products (TOTAL_PR). It was defined regarding the production achieved in recent years before the lagoon became too polluted. The fifth attribute is monetary (TAX). The level of attribute TAX was selected after consultation with fishermen through open-ended questions and focus groups. The attribute TAX refers to the tax fishermen must pay per invoice for fishing products caught.

TABLE 1 Description of attributes.

Attributes	Codification in the model	Levels (from Lowest to highest level)
Water quality	WQ1 (reference level), Water_2, Water_3, Water_4	1. Slight improvement in water clarity, nasty odor, abundance of harmful algae 2. Slight improvement in water clarity and odor with reduced abundance of harmful algae 3. Water moderately clear, smell moderately disappeared, harmful algae notably disappeared 4. Good water clarity, no harmful algae, no smell
Biodiversity	BIODIV_1 (reference level), BIODIV_2, BIODIV_3, BIODIV_4	1. Biodiversity slightly improved with the non-valorization of invasive species 2. Biodiversity moderately improved with the non-valorization of invasive species 3. Notable existence of missing species and valorization of some invasive species 4. Existence of all missing species and full valuation of invasive species
Total annual production (tons/year)	TOTAL_PR	76T, 90T, 124T, 164T
Port organization	PORT1 (reference level), PORT2	
Tax (% per fishery "products" capture bill) Period: 5 years	TAX	10%, 11%, 12%, 13%

Given its importance in determining whether or not the estimates of values and preference parameters with efficiency yield an unbiased statistical target, we created a D-efficient design (Rose and Bliemer, 2009) by combining these attributes and their levels using the Ngene software (Hensher et al., 2015) to model 12 choice sets. According to Hoyos (2010), the advantage of the efficient design is that it helps develop an experimental design when the required sample size is small. To compare the statistical efficiency of the different designs/outputs of Ngene, the preferred measure in the literature is the D-error. We chose the design with the lowest D-error value (Rose and Bliemer, 2009), in our case 0.25. We also included a separate sheet with clearer cards and levels to better explain the attributes (Carlsson et al., 2010) to reduce hypothesized biases within the choice sets (Carlsson et al., 2003). An example of a choice set is shown in Table 2.

2.2. Data analysis

The collected choice data were analyzed within a random utility framework (McFadden, 1973). Thus, an individual n presented with j alternatives/scenarios in a choice set t is expected to choose the alternative that maximizes his/her utility. Following Lancaster's theory of value (Lancaster, 1966), the utility that an individual n derives from consuming a product/service is the sum of his/her marginal utility for each one of the product's attributes. Consequently, if a sample of N individuals are presented with T choice sets of J alternatives each, individual n's utility (U_{jn}) takes the form:

$$U_{jn} = V_{nj} + \varepsilon_{nj} \quad (1)$$

where V_{nj} is the deterministic (observed) component and ε_{nj} is the random (unobserved) component. ε_{nj} are assumed to be independent and identically distributed.

Assuming that the deterministic component is linear-in-parameter, Eq. (1) can be written as:

$$U_{nj} = \beta X_{nj} + \varepsilon_{nj} \quad (2)$$

where β denotes the vector of unknown utility parameters. In this study, X_{nj} represents the following levels of attributes: BIODIV_2, BIODIV_3, BIODIV_4, Water_2, Water_3, Water_4, TAX, TOTAL_PR, PORT_2. The variables BIODIV_2, BIODIV_3, BIODIV_4, Water_2, Water_3, Water_4, and PORT_2 are coded as dummy variables. The variables TAX and TOTAL_PR are continuous variables. The coding is described in Table 3. The levels BIODIV_1, Water_1, and PORT_1 were dropped from the estimation to avoid the problem of perfect multicollinearity. They are also used as reference levels when interpreting the estimated parameters. The preferences for the status quo are captured by the dummy variable ASC_SQ (see Table 3 for a description of all the variables used in the estimation of the choice model).

A conditional logit model (McFadden, 1974) was used to estimate the utility parameters β. In the conditional logit model (CL), the stochastic error term ε_{nj} in Eq. 2 is specified as an extreme value distribution of type 1 that is independently and identically distributed so that the probability that a person n chooses alternative j from h alternatives can be expressed in this form:

$$P_{nj}(\beta) = \frac{exp(\beta X_{nj})}{\sum_{j=1}^{h} exp(\beta X_{nj})} \quad (3)$$

TABLE 2 Example of choice sets.

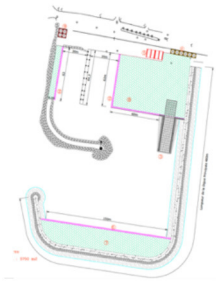
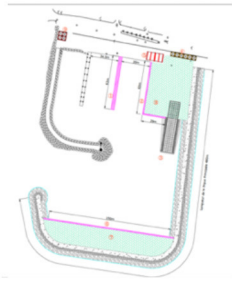
	Option 1	Option 2	Current situation
Biodiversity	Notable existence of missing species and valorization of certain invasive species	Existence of all missing species and full valuation of invasive species	Degradation of the biodiversity and abundancy of invasive species
Port organization			
Water quality	Slight improvement in water quality, existence smell with an abundance of harmful algae	Water moderately clear, smell moderately disappeared, harmful algae notably disappeared	Uncleared water, excessive harmful algae, smell noticeable
Total annual production (T/year)	76	124	69
Tax (% per bill)	11	13	9
Choice	I choose option 1	I choose option 2	I would not choose any of the two options

TABLE 3 Description of variable considered in the choice analysis.

BIODIV_2	Is coded as 1 if the biodiversity level is "Slight improvement in water clarity and odor with reduced abundance of harmful algae," and 0 otherwise
BIODIV_3	Is coded as 1 if the biodiversity level is "moderately improved with the non-valorization of invasive species," and 0 otherwise
BIODIV_4	Is coded as 1 if the biodiversity level is "Notable existence of missing species and valorization of some invasive species," and 0 otherwise
Water_2	Is coded as 1 if the water level is "Slight improvement in water clarity and odor with reduced abundance of harmful algae," and 0 otherwise
Water_3	Is coded as 1 if the water level is "Water moderately clear, smell moderately disappeared, harmful algae notably disappeared," and 0 otherwise
Water_4	Is coded as 1 if the water level is "Good water clarity, no harmful algae, no smell," and 0 otherwise
PORT_2	Is coded as 1 if port organization is "the tail of the port (east side) is completed, rehabilitation of the port by setting up a special center of National Guard, building toilets, rehabilitating the ice supply plant," and 0 otherwise
Tax	Is a continuous variable that takes the value of 10%, 11%, 12%, or 13%
TOTAL_PR	Is a continuous variable that takes the value of 76T, 90T, 124T, 164T

With the standard assumptions that systematic utility is linear in parameters, the CL can be estimated by finding the values of the βs that maximize the log-likelihood function shown below:

$$Ln\,L = \sum_{n=1}^{N} \sum_{j \epsilon T} Y_{nj} \left(\ln \left(P_{nj} \right) \right)$$

$$= \sum_{n=1}^{N} \sum_{j \epsilon T} Y_{nj} \left(\beta X_{nj} - ln \sum_{j \epsilon T} exp(\beta X_{nj}) \right) \quad (4)$$

where N is the total sample size, and Y^{jn} is a choice indicator that takes the value of 1 if individual n chooses alternative j in the choice set T.

The authors assumed that the CL has strong and restrictive assumptions. In particular, it assumes that (1) preferences are homogeneous across respondents, (2) choices are Independent of Irrelevant Alternatives (IIA), and (3) that random components are Independent and Identically Distributed (IID) (McFadden, 1974). This is why authors first tried to estimate the utility parameters using the most flexible choice model: the Random Parameter Logit model (RPL). The RPL allows respondents' preferences to be heterogeneous and the assumption of the Independence of Irrelevant Alternatives to be relaxed. Unfortunately, the estimation did not converge. For this reason, authors decided to estimate a CL model. The estimated marginal utilities using the CL are presented in Table 5.

3. Results and discussion

3.1. Respondents' characteristics and a description of their attitudes

First, the characteristics of the fishermen interviewed are examined. Table 4 presents descriptive statistics on some socio-demographic characteristics of the sampled respondents. The age average of respondents is 48 years. The average work experience is 27 years which is statistically different from the population average. This questionnaire showed that there is a significant number of fishers whose ages are more than 65 years old.

TABLE 4 Descriptive statistics for some socio-economic variables of respondents.

Variables	Description	Percentage of sample	Percentage[a] of population
Age (Mean)	Mean	48,1	44,6
Income (%)	Between (1,000–1,500)	52%	67%
Education (%)	Expressed by percentage if fisherman education level is primary	42%	49%
Boat-license	Expressed by percentage if fisherman is owner of a boat	80%	89%
Family size (mean)	The number of family members	3,72	–
Origin	Expressed by percentage if fisherman origin is *Manzel Abderrahmen*	80%	83%
Experience	Years of experience in the field	27,35	23

[a]Informations were provided and confirmed by DGPA (Direction Générale de la Pêche et d'Aquaculture), Manzel Abderrahmen.

The average monthly income of 52% of the respondents was <1,500 Tunisian Dinars[8] (301 euros). According to them, this income is not enough to cover the monthly expenses for the family (family size 3.72 members) and the maintenance of the boat. This may partially explain why 22% of the fishermen revealed to have a second job in addition to fishing. Regarding the respondents' connection with fishing, 53.42% had at least one family member working (even if temporarily) in fishing. All of them have a primary and secondary educational level. Three-quarters of fishers are already having a boat license. Furthermore, almost the entire sample is from *Manzel Abderrahmen*.

The fishermen were asked about the reasons they could give to explain the current situation mentioned below. It is interesting to note that all respondents indicated that the industry's unfamiliarity with the environmental standards they must meet and the government's lack of enforcement of laws related to those environmental standards are the main reasons for the deterioration of the lagoon ecosystem, followed by shellfish farming and agriculture. Also, they were debriefed about work conditions in the port and if they were interested in the completion of the port infrastructure. According to them, the port has a direct effect on work conditions and livelihood. The majority expressed their interest in completing the design of the port because it lacks several basic facilities such as toilets, potable water, and electricity.

3.2. Respondents' preferences

As mentioned by Birol et al. (2006), ρ^2 in CL models is equivalent to R^2 in a typical linear regression analysis. According to Hensher and Johnson (1981), values of ρ^2 between 0.2 and 0.4 are considered a good fit. In our case, $\rho^2 = 0.4$. The results show that the level of port organization (POR_2) is the only significant attribute level in this study. All the other levels of attributes are insignificant. This means, among others, that fishermen would be indifferent between paying tax rates 10%, 11%, 12%, or 13% for the maintenance of the lagoons and harbors (Table 5). This result answered the *of* the present research which suggest to see whether fishermen are sensitive to the tax vector mentioned in the survey.

The results showed that only the port organization is significant, which means that the organization of the port seems to be the most and the only important attribute of the five attributes considered in this study. This finding answers the *of* the present research about the importance the harbor represents for the fishers. Many studies have looked at the importance that local communities place on legacy values. According to these studies, people develop a unique relationship with sites and ecosystems through interaction with values and tend to manage them because they shape their identity and provide continuity to their culture (Oleson et al., 2015). The port was expected to be the most relevant attribute, as almost the entire sample is from *Manzel Abderrahmen*. So, they are interested in conserving their port. Fishers with a boat license showed their interest in completing the rehabilitation of the port as it would benefit them to protect both their boat and the port.

Several visits to the lagoon took place before conducting the face-to-face survey to better understand the social context of fishers. One of the most important characteristics of the fishermen of *Manzel Abderrahmen* is their deep attachment to the port. For them, the port is not only a source of income but also a cultural heritage that is passed on to the next generation. One of the main points that stood out to them was that, in their opinion, the port belongs to them and not to the government. Two months after, we learned that they have been waiting for the government to intervene to complete managing the port since 1995. The problem is that failure to maintain the port can cause its infrastructure to deteriorate and be lost over time. On the other hand, incomplete planning also affects fishermen. "*We spend the night in the port when it is windy or stormy because we are afraid that the boat will sink, and if that happens, it is costly to repair it.*" explained one of them.

In addition, fishermen went on strike for more than a month in October 2019 to put pressure on governmental authorities to respond to their demands for the completion of port infrastructure. Although they expressed concern about the environment, water quality, and biodiversity in other survey questions, when we asked them to find a compromise between these attributes and the legacy attribute "PORT2," they prioritized the latter.

To validate these results, we interviewed seven fishermen who participated in the DCE 2 months (January–February 2022) after finishing the DCE-based survey to share the results and ask for their feedback. The interview consisted in asking them whether they were or not expecting some of the study findings including

8 1euro = 3.32 Tunisian Dinars (conversion 2023).

TABLE 5 Results from the estimation of the CL model: respondents' preferences.

Parameters	Coefficients	SE	*Z*	Prob. $z\|>Z^*$
BIODIV_2	0.03594	0.08879	0.40	0.6856
BIODIV_3	0.12231	0.10204	1.20	0.2307
BIODIV_4	0.17611	0.15078	1.17	0.2428
Water_2	0.00470	0.09805	0.05	0.9617
Water_3	0.06487	0.11014	0.59	0.5559
Water_4	0.10735	0.15487	0.69	0.4882
TAX	0.01977	0.21312	0.21312	0.9261
TOTAL_PR	0.00379	0.00322	0.00322	0.2388
PORT_2	0.20888***	0.05212	0.05212	0.0001
ASC_SQ	−0.82408	2.54155	254.155	0.7458

***, **, * Significance at 1%, 5%, 10% level.

the fact that *"fishing community are just interested in conserving the port."* Six out of seven fishermen agreed with the results. The explanations vary from fisherman to fisherman. For example, one of them explained these results, saying *"We could give importance to the water quality and biodiversity in the lagoon if the port could be completed."* Another essential factor that can be considered as an explanation for the lack of concern for the environmental attributes is the fact that they are concerned about the factors that can affect their livelihood in the short run: *"We are paying 9% to the APIP, and we do not have the minimum conditions for safe work: potable water, toilets and a safe place to leave our boats without worrying about it. So, we are willing to pay up to 13% to improve port management."*

To understand their sensitivity to the monetary attribute (tax), we also tried to see whether fishers are willing or not to pay more than 13% as a tax to the APIP. They disagreed with the idea and ensured they were willing to pay up to 13%. This result responds to the *o*f the present research regarding the role of taxes as a limiting factor of fishers' preferences.

4. Conclusion and recommendation

These results reflect the importance that the fishermen of *Manzel Abderrahmen* attach to the port compared to the other services that can be provided directly or indirectly by the lagoon of Bizerte. Insignificant coefficients related to the environment do not mean that they are not aware of the deterioration of the situation in the lagoon; on the contrary, when the fishermen were asked at the beginning of the survey if they noticed species extinction in the lagoon or if the products, they catch are still the same as 10 years ago, or if they are aware of the pollution of the lagoon, the answers showed that they are up to date on what exactly is happening. For example, they gave the names of the species that disappeared, and they described how the color of the water is affected by the pollution (red in summer), how the smell bothers them and how the taste of the fish has changed. Highlighting this point, we responded to the *e*nsuring that they are interesting is the environmental dimension. Therefore, fishermen may prioritize the other attributes if the port organization is improved. In other words, it seems that the marginal utility of the port organization could not be substituted by those of the other attributes (O'Garra, 2009) because fishermen, when they are called to trade-off between the levels, prioritize the port as they tend to establish a relationship of trust with the port (O'Garra, 2009). Therefore, understanding the importance of legacy values and the value fishermen place on the port organization is critical to whether or not government institutions are appropriately approached (Oleson et al., 2015). Therefore, for an efficient feasibility study, decision-makers need to consider non-use values to ensure a more realistic study [Total Economic Value (TEV) and Cost-Benefit Analysis (CBA)] that considers the environmental and socio-economic dimensions. It is essential to consider social indirect values when analyzing preferences for public challenges as it adjust public estimations for implementing correct measures when implementing public projects.

These results reflect another profile of respondents, who showed their environmentally friendly beliefs. However, when they have to make the trade-off between the environmental and the social dimension, they tend to choose the social dimension, which reflects their identity.

We emphasize that through this exercise, fishermen want to address a message by proposing short-term management measures concerning the organization of the port and its structure to improve the situation.

It is crucial that fishermen feel involved in decisions that affect their environment and that they play an influential role in ensuring the ecosystem's continued existence. The government needs to raise awareness among fishermen by organizing educational events to help them understand environmental responsibility and ensure long-term sustainability.

It's also important to highlight that fishermen believe that regulations exist but they are not applied as they should be. Strengthening awareness-raising actions involving civil society is necessary to ensure a participatory approach and good governance. Authorities (Ministry of Agriculture, APIP, DGPA) must increase the number of visits with fishermen to ensure lateral communication where the fisherman can react and act and vice versa.

These results define a context within a spatial and temporal framework that concerns a well-defined sample chosen according to the objective of this study (according to the project plans).

In the end, comparing these results with results obtained from other studies seems challenging because all contexts, attitudes and beliefs are different. Valued good is different, too.

Therefore, these results remain valid until there will be future studies conducted in Tunisia or another country with a similar context (sample) assessing the preferences of fishermen where there will not be, for example, a problem with the port organization (case of the big port of Zarzouna, for example) to allow fishermen to make trade-off based only on environmental and economic attributes to target his attitudes toward the environment. It is also important to point out that it will be necessary to examine the opinion of people not from *Manzel Abderahmen* to target their attitude and preference toward heritage.

The findings will serve to better understand how social demand for port preservation can mask other interests that may be important but need to be prioritized. We hope that another model study can be conducted in a different context in which the port is managed, and we can then consider its environmental attributes.

5. Limitations of the case study

It is true that stated preference methods and choice experiments in particular, become ensconced in environmental valuations, but particular attention has to be paid to the hypothetical bias (Johnston et al., 2017). Using hypothetical survey methods represents one of the fundamental issues of Choice Experiment (Haghani et al., 2021). Despite being an "undeniable problem and an empirical" when conducting choice experiments, this cannot assume that CE cannot represent the real preferences (Haghani et al., 2021). From a design point of view, we tried to maximize the validity and reliability of the estimated resulting value. As authors, we tried implementing a good survey design to avoid the hypothetical bias in estimates and minimize variability (Haghani et al., 2021). From a survey conduction point of view, we tried to catch the information without influencing fishers' responses. According to Rossi et al. (1983), respondents may overstate their contribution due to interviewer influence, called "Social desirability bias." They respond in ways they think the interviewer wants to hear or, in some cases, it can be caused by the charity in response as they perceive that charitable giving is a social activity. More attention should be paid when conducting the DCE because the more we identify the source of hypothetical bias, the more we represent real preferences.

Data availability statement

The datasets generated and analyzed for this study will be available by authors without reservation.

Ethics statement

Ethical approval was not required for the study involving human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was not required from the participants in accordance with the national legislation and the institutional requirements. The survey was carried out in compliance with the guidelines of the Tunisian National Authority for Protection of Personal Data (INPDP) and the respondents' identities were not documented.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

This study has been funded by the Centro de Recerca en Economia i Desenvolupament Agroalimentari (CREDA), Parc Mediterrani de la Tecnologia, Barcelona, Spain.

Acknowledgments

This short text acknowledges the contributions of specific institutions such as the Tunisian National Institute of Sciences and Marine Technologies (INSTM), General Direction of Fishing and Aquaculture (DGPA, Tunisia), and Ports and Fisheries Facilities Agency (APIP, Tunisia) and some specific colleagues that aided the authors' efforts.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

References

Afli, A., Boufahja, F., Sadraoui, S., Mustapha, K. B., Aïssa, P., Mrabet, R., et al. (2009). Functional *Organization* of the *Benthic Macrofauna* in the Bizerte lagoon (SW Mediterranean Sea), *Semi-Enclosed Area Subject to Strong Environmental/Anthropogenic Variations.*

Agbekpornu, H., Yeboah, D., Quaatey, S., Williams, R., and Yeboah, R. (2014). *Willingness To Participate In Life Insurance Scheme By Artisanal Fishers In.* 12.

Agimass, F., and Mekonnen, A. (2011). Low-income fishermen's fishermen's willingness-to-payfor fisheries and watershed management: an application of choice experiment to Lake Tana, Ethiopia. *Ecol. Econ.* 71, 162–170. doi: 10.1016/j.ecolecon.2011.08.025

Barhoumi, B. (2014). *Biosurveillance de la Pollution de la Lagune de Bizerte (Tunisie) par l'analyse Comparée des Niveaux de Contamination et de L'écotoxicité des Sédiments et du Biote* 349.

Beharry-Borg, N., and Scarpa, R. (2010). Valuing quality changes in Caribbean coastal waters for heterogeneous beach visitors. *Ecol. Econ.* 69, 1124–1139. doi: 10.1016/j.ecolecon.2009.12.007

Béjaoui, B., Harzallah, A., Moussa, M., Chapelle, A., and Solidoro, C. (2008). Analysis of hydrobiological pattern in the Bizerte lagoon (Tunisia). *Estuar. Coast. Shelf Sci.* 80, 121–129. doi: 10.1016/j.ecss.2008.07.011

Ben Garali, A., Ouakad, M., and Gueddari, M. (2011). Geochemistry of Bizerte lagoon affluent water, Northern Tunisia: principal component analysis. *Arab. J. Geosci.* 4, 475–481. doi: 10.1007/s12517-010-0128-z

Ben Salem, F., Ben Said, O., Cravo-Laureau, C., Mahmoudi, E., Bru, N., Monperrus, M., et al. (2019). Bacterial community assemblages in sediments under high anthropogenic pressure at Ichkeul Lake/Bizerte Lagoon hydrological system, Tunisia. *Environ. Pollut.* 252, 644–656. doi: 10.1016/j.envpol.2019.05.146

Ben Salem, F., Ben Said, O., Mahmoudi, E., Duran, R., and Monperrus, M. (2017). Distribution of organic contamination of sediments from Ichkeul Lake and Bizerte Lagoon, Tunisia. *Mar. Pollut. Bull.* 123, 329–338. doi: 10.1016/j.marpolbul.2017.09.024

Birol, E., Karousakis, K., and Koundouri, P. (2006). Using a choice experiment to account for preference heterogeneity in wetland attributes: the case of Cheimaditida wetland in Greece. *Ecol. Econ.* 60, 145–156. doi: 10.1016/j.ecolecon.2006.06.002

Carlsson, F., Frykblom, P., and Liljenstolpe, C. (2003). Valuing wetland attributes: an application of choice experiments. *Ecol. Econ.* 47, 95–103. doi: 10.1016/j.ecolecon.2002.09.003

Carlsson, F., Kataria, M., and Lampi, E. (2010). Dealing with ignored attributes in choice experiments on valuation of Sweden's environmental quality objectives. *Environ. Resour. Econ.* 47, 65–89. doi: 10.1007/s10640-010-9365-6

Cheng, X., Van Damme, S., Li, L., and Uyttenhove, P. (2019). Evaluation of cultural ecosystem services: a review of methods. *Ecosyst. Serv.* 37, 100925. doi: 10.1016/j.ecoser.2019.100925

Direction Générale de la Pêche et d'Aquaculture (DGPA) (2018). *Annuaire Statistique 2018*. Available online at: http://www.onagri.nat.tn/uploads/statistiques/Annuaire-statistique-peche2018.pdf (accessed 2023).

Direction Générale de la Pêche et d'Aquaculture (DGPA) (2020). *Annuaire Statistique 2020*. Available online at: http://www.onagri.nat.tn/uploads/statistiques/Annuaire-statistique-peche2020.pdf (accessed 2023).

Doherty, E., Murphy, G., Hynes, S., and Buckley, C. (2014). Valuing ecosystem services across water bodies: results from a discrete choice experiment. *Ecosyst. Serv.* 7, 89–97. doi: 10.1016/j.ecoser.2013.09.003

Duijndam, S., van Beukering, P., Fralikhina, H., Molenaar, A., and Koetse, M. (2020). Valuing a Caribbean coastal lagoon using the choice experiment method: the case of the Simpson Bay Lagoon, Saint Martin. *J. Nat. Conserv.* 56, 125845. doi: 10.1016/j.jnc.2020.125845

Durán, R., Farizo, B. A., and Vázquez, M. X. (2015). Conservation of maritime cultural heritage: a discrete choice experiment in a European Atlantic Region. *Mar. Policy* 51, 356–365. doi: 10.1016/j.marpol.2014.09.023

Goncuoglu Bodur, H., Ayan, M., Ozcan, M., and Tosunoglu, Z. (2017). [No title found]. *Turk. J. Fish. Aquat. Sci.* 17, 7–14. doi: 10.4194/1303-2712-v17_1_02

Haghani, M., Bliemer, M. C. J., Rose, J. M., Oppewal, H., and Lancsar, E. (2021). Hypothetical bias in stated choice experiments: Part II. Conceptualisation Conceptualization of external validity, sources and explanations of bias and effectiveness of mitigation methods. *J. Choice Model.* 41, 100322. doi: 10.1016/j.jocm.2021.100322

Hensher, D. A., and Johnson, L. W. (1981). Behavioural response and form of the representative component of the indirect utility function in travel choice models. *Reg. Sci. Urban Econ.* 11, 559–572. doi: 10.1016/0166-0462(81)90038-7

Hensher, D. A., Rose, J. M., and Greene, W. H. (2015). *Applied Choice Analysis*, 2nd ed. Cambridge: Cambridge University Press. doi: 10.1017/CBO9781316136232

Hoyos, D. (2010). The state of the art of environmental valuation with discrete choice experiments. *Ecol. Econ.* 69, 1595–1603. doi: 10.1016/j.ecolecon.2010.04.011

Johnston, R. J., Boyle, K. J., Adamowicz, W. (Vic), Bennett, J., Brouwer, R., Cameron, T. A., et al. (2017). Contemporary guidance for stated preference studies. *J. Assoc. Environ. Resour. Econ.* 4, 319–405. doi: 10.1086/691697

Lancaster, K. J. (1966). A new approach to consumer theory. *J. Polit. Econ.* 74, 132–157. doi: 10.1086/259131

Lee, D., Hosking, S., and Du Preez, M. (2014). A choice experiment application to estimate willingness to pay for controlling excessive recreational fishing demand at the Sundays River Estuary, South Africa. *Water SA* 40, 39. doi: 10.4314/wsa.v40i1.5

Legg, P., Hatton MacDonald, D., Bark, R. H., Tocock, M., Tinch, D., and Rose, J. M. (2020). Cultural values, deep mining operations and the use of surplus groundwater for towns, landscapes and jobs. *Ecol. Econ.* 178, 106808. doi: 10.1016/j.ecolecon.2020.106808

Martínez-Paz, J. M., Perni, A., and Martínez-Carrasco, F. (2013). Assessment of the program of measures for coastal lagoon environmental restoration using cost–benefit analysis. *Eur. Plann. Stud.* 21, 131–148. doi: 10.1080/09654313.2012.722923

McFadden, D. (1973). "Conditional logit analysis of qualitative choice behavior," in *The Frontiers in Economics*, ed. P. Zarembka (New York, NY: Academic Press), 105–142.

McFadden, D. (1974). The measurement of urban travel demand. *Public Econ.* 3, 303–328. doi: 10.1016/0047-2727(74)90003-6

Millennium Ecosystem Assessment (Program, MES) (Ed.). (2005). *Ecosystems and Human well-Being: Synthesis*. Washington, DC: Island Press.

Molinos-Senante, M., Garrido-Baserba, M., Reif, R., Hernández-Sancho, F., and Poch, M. (2012). Assessment of wastewater treatment plant design for small communities: environmental and economic aspects. *Sci. Total Environ. 427–428*, 11–18. doi: 10.1016/j.scitotenv.2012.04.023

Mulatu, D. W., Oel, P. R., Odongo, V., and Veen, A. (2018). Fishing community preferences and willingness to pay for alternative developments of ecosystem-based fisheries management (EBFM) for Lake Naivasha, Kenya. Lakes Reserv. *Sci. Policy Manag. Sustain. Use* 23, 190–203. doi: 10.1111/lre.12225

Nunes, P. A. L. D., Loureiro, M. L., Piñol, L., Sastre, S., Voltaire, L., Canepa, A., et al. (2015). Analyzing beach recreationists'preferences for the reduction of jellyfish blooms: economic results from a stated-choice experiment in Catalonia, Spain. *PLOS ONE* 10, e0126681. doi: 10.1371/journal.pone.0126681

Observatoire National de l'Agriculture (ONAGRI) (2020). *Annuaire Statistique 2020*. Available online at: http://www.onagri.nat.tn/uploads/statistiques/Annuaire-Statistique-2020VF.pdf (accessed 2023).

O'Garra, T. (2009). Bequest values for marine resources: how important for indigenous communities in less-developed economies? *Environ. Resour. Econ.* 44, 179–202. doi: 10.1007/s10640-009-9279-3

Oleson, K. L. L., Barnes, M., Brander, L. M., Oliver, T. A., van Beek, I., Zafindrasilivonona, B., et al. (2015). Cultural bequest values for ecosystem service flows among indigenous fishers: a discrete choice experiment validated with mixed methods. *Ecol. Econ.* 114, 104–116. doi: 10.1016/j.ecolecon.2015.02.028

Owa, F. D. (2014). Water pollution: sources, effects, control and management. *Int. Lett. Nat. Sci.* 3, 1–6. doi: 10.5901/mjss.2013.v4n8p65

Perni, A., Martínez-Carrasco, F., and Martínez-Paz, J. (2011). Economic valuation of coastal lagoon environmental restoration: Mar Menor (SE Spain). *Cienc. Mar.* 37, 175–190. doi: 10.7773/cm.v37i2.1889

Reed Johnson, F., Lancsar, E., Marshall, D., Kilambi, V., Mühlbacher, A., Regier, D. A., et al. (2013). Constructing experimental designs for discrete-choice experiments: report of the ISPOR conjoint analysis experimental design good research practices task force. *Value Health* 16, 3–13. doi: 10.1016/j.jval.2012.08.2223

Remoundou, K., Diaz-Simal, P., Koundouri, P., and Rulleau, B. (2015). Valuing climate change mitigation: a choice experiment on a coastal and marine ecosystem. *Ecosyst. Serv.* 11, 87–94. doi: 10.1016/j.ecoser.2014.11.003

Rose, J. M., and Bliemer, M. C. J. (2009). Constructing efficient stated choice experimental designs. *Transp. Rev.* 29, 587–617. doi: 10.1080/01441640902827623

Rossi, P. H., Wright, J. D., and Anderson, A. B. (eds.) (1983). *Handbook of Survey Research, Quantitative Studies in Social Relations*. New York, NY: Academic Press.

Smyth, R. L., Watzin, M. C., and Manning, R. E. (2009). Investigating public preferences for managing Lake Champlain using a choice experiment. *J. Environ. Manage.* 90, 615–623. doi: 10.1016/j.jenvman.2007.12.016

Tan, Y., Lv, D., Cheng, J., Wang, D., Mo, W., Xiang, Y., et al. (2018). Valuation of environmental improvements in coastal wetland restoration: a choice experiment approach. *Glob. Ecol. Conserv.* 15, e00440. doi: 10.1016/j.gecco.2018.e00440

Toumi, H., Abidli, S., and Bejaoui, M. (2019). Microplastics in freshwater environment: the first evaluation in sediments from seven water streams surrounding the lagoon of Bizerte (Northern Tunisia). *Environ. Sci. Pollut. Res.* 26, 14673–14682. doi: 10.1007/s11356-019-04695-0

Wang, H., He, J., Kim, Y., and Kamata, T. (2013). Willingness-to-pay for water quality improvements in Chinese rivers: an empirical test on the ordering effects of multiple-bounded discrete choices. *J. Environ. Manage.* 131, 256–269. doi: 10.1016/j.jenvman.2013.07.034

Wattage, P., and Mardle, S. (2008). Total economic value of wetland conservation in Sri Lanka identifying use and non-use values. *Wetl. Ecol. Manag.* 16, 359–369. doi: 10.1007/s11273-007-9073-3

Wright, W. C. C., and Eppink, F. V. (2016). Drivers of heritage value: a meta-analysis of monetary valuation studies of cultural heritage. *Ecol. Econ.* 130, 277–284. doi: 10.1016/j.ecolecon.2016.08.001