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Supporting BLUE Growth: Eliciting Stakeholders' preferences for Multiple-Use Offshore Platforms

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Abstract

The objective of this paper is to elicit stakeholder preferences in relation to different Multiple Use Offshore Platforms (MUOP) designs produced by the TROPOS project (www.troposplatform.eu) for the Liuqiu Island, Taiwan using the Choice Experiment (CE) method. To authors´ acknowledge, this is the first non-market valuation of multiple use offshore platforms and definitely the first using CE in this context. The MUOP concept is defined as a floating platform moored in Taiwan shallow waters located offshore and concerned as a sustainable and ecologic location, which supports the development of the local economy and serves as an example of sustainable development in offshore environments. The CE was conducted on tourists and residents of the area. A ranking preference technique with visual aids was used, in order to obtain a more complete characterization of the respondents' preference structure. The attributes used were the environmental impacts of the modules (using an ecosystem services approach), the level of mitigation, the existence of renewable energy production and leisure facilities. The results show that residents would be less likely to support the development of such a project, compared to tourists that would be willing to pay a daily tax for the leisure and renewable energy facilities.

Keywords: Choice Experiment, Multiple Use Offshore Platform, Ranking Preference technique

1 INTRODUCTION

In line with welfare economics thinking, changes in the circumstances affect individuals and their welfare. Thus, for policy implementation purposes it is important to investigate firstly, the possible impacts of the change and based on that to define the individuals whose welfare is likely to change. In a broader context, these changes could be the introduction of new policy schemes, increase or decrease of environmental services, the construction of a large or small scale infrastructure. For example, Ladenburg et al. (2007), recognize that significant disamenities dwell from the construction of offshore wind farms. In this context using the CEM, they investigate the individuals' willingness to pay to mitigate the visual disturbance created by the offshore wind turbines. Although, an extensive part of the literature recognizes that visual impacts of large off-shore constructions is one of the main factors that affect public´s acceptance of such constructions (Bishop and Miller 2007; Tsoutsos and Tsouchlaraki 2009; Ladenburg 2008), it is also recognized that there is a significant welfare effect in terms of environmental impacts from such constructions (Álvarez-Farizo et al., 2002; Busch et al., 2011). Therefore, it is evident that offshore infrastructure affects individuals´ welfare.

An important issue to every valuation exercise is the identification of the population whose welfare is likely to change, subject to the introduction of infrastructure in the sea. While it can undoubtedly be admitted that local residents should be regarded as part of this population, it would make sense that visitors to coastal areas, enjoy benefits or bear costs due to the existence of off-shore platforms. For example, Paudel et al., (2011) examined the characteristics of the visitors and the characteristics of the Lousiana coast in an effort to determine the characteristics that affect choosing a site for recreational purposes. Their results showed that the environmental level of environmental quality of the visiting site is of major importance for the tourists to either accept or reject travelling to that specific site.

The state of the environment of coastal areas is of great importance for the local residents that are the direct receptors of any ecological degradation. This is due to the fact that, environmental services are associated with use and non-use values. Changes in the level of services can thus, increase or decrease the resident´s welfare. For example, coastal pollution may lead to extinction of fish, which would lead to welfare costs in term of lost income. On the other hand, lower levels of the ecological status of coastal waters may lead to decreases in the recreational value of the coast that affects both locals and tourists. However, tourism depends on changes of coastal environments that can potentially degrade natural resources (Concu and Atzeni 2012). Brau (2008) show that environmental degradation has significant negative effects on tourists´ welfare. Lindberg et al., (2001) assessed the impacts on welfare of the hypothetical development of a ski resort. They found that a segment of the population of residents would gain from such a project, whereas another segment would face significant losses. On the other hand, tourists would also benefit from such an expansion, but the total gains would not outweigh the losses, which would result in decreased social welfare if such an expansion occurred.

In consequence, it is necessary to distinguish between the local population and tourists when examining the development of coastal areas, due to the heterogeneity in the preferences between host communities and tourists. Another important issue in coastal development is the host community's attitudes towards tourism development. For example, Lindberg et al., (1999) examined locals preferences of tourism development that would yield environmental and social impacts. Their findings point out that on the island of Børnholm (Denmark) the attitudes towards tourism development that would generate income but also traffic, are different across local communities. In some cases, some communities desired significant lower levels of development than others. In line with this, Apostolakis et al., (2005) used Choice Modelling to investigate heterogeneity in tourists preferences for two attractions. Overall they found that exacerbation of congestion on the site leads to lowering their utility, although the visitors were not sensitive to such changes. Additionally, another result is that increase in the services provided was valued positively by the tourists. The divergence of tourists and residents is evident in Hearne et al., (2005). The authors investigated the similarities in preferences towards alternative scenarios of ecotourism of local residents and tourists. As demonstrated by the results, these two populations are willing to accept an entrance fee and prefer enhancement of the management of the park, but they have different opinions about paved access and the presence of illegal colonists. Apart from difference between host communities and visitors from its essential to understand the heterogeneous attitudes of residents. This claim has been recognized by the literature that has been presented already, but also by literature that revolved around tourism and development of projects (Tomljenovic et al., 2000;Pearce et al., 1996; Mason et al., 2000). In line with the literature, the objective of this paper is to elicit stakeholder preferences in relation to different Multiple Use Offshore Platforms (MUOP) designs produced by the TROPOS project (www.troposplatform.eu) for the Liuqiu Island, Taiwan using the Choice Experiment (CE) method.This method has been extensively used to investigate the preferences of the individuals in relation to environmental, natural resource, agricultural, food, energyissues among others (Birol&Koundouri, 2008).

The MUOP concept is defined as a floating platform moored in Taiwan shallow waters (depth margins from 20 to 500m meters depth), located between 5 and 10 miles offshore and concerned as a sustainable and ecologic location. It is expected that this concept's realization will support the development of the local economy and will serve as an example of sustainable development in offshore environments. In addition, it is expected that it will provide further opportunities in the field of "blue" economy for Taiwan. The Choice Experiment was conducted on tourists and residents of the area. The choice cards used visual aids in order to improve the respondents' comprehension of the structure of the platform. The attributes used were the environmental impacts of the modules, the level of mitigation and the existence of renewable energy production and leisure facilities.

The results of this study can be used in the implementation of the Blue Growth strategy and the innovative use of seas and oceans to achieve and economic growth, in order to tackle societal challenges (COM/2012/0494/Final). The realization of the Changhua offshore pilot project in Taiwan and the interest of the Taiwanese government to use its offshore resources, make the results of this study of high relevance to worldwide governmental initiatives.

1.1 GREEN&BLUE CONCEPT IN TAIWAN

The Green & Blue platform concept ofLiuqiu Island combines offshore fish and algae aquaculture with OTEC (Ocean Thermal Energy Conversion) for energy supply. Table 1.2.1 demonstrates the conceptual design for central unit.

Table 1 Components and services of the Green & Blue platform scenario of Liuqiu island

MODULES	**COMPONENTS/SERVICES**	
Fish Aquaculture	Fish Aquaculture parts of the 30 Satellite Units	Fish Aquaculture Module (on CU, operation and control)
Algae Aquaculture	Algae Aquaculture parts of the 30 Satellite Units	Algae Aquaculture Module (on CU, operation and control)
	Biorefinery, accommodation, storage (on CU)	
Processing Plant (CU)	Storage	Processing, packaging, freezing
OTEC Planta	Energy generation	
Accommodation	Hotels for tourists and relative services	

Figure 1 Green & Blue- Taiwan- Central Unit Conceptual Design

The Green & Blue concept is focused on the use of energy and biological ocean resources. This concept combines aquaculture facilities (both fish and algae) with OTEC in Taiwan. All the platform energy needs will be provided by the renewable energy modules. A total of 5 modules and a satellite type will be designed to fulfill this objective.

The Green & Blue concept is defined as a floating platform moored in Taiwan shallow waters (depth margins from 20 to 500m meters depth), located between 5 and 10 miles offshore and concerned as a sustainable and ecologic location. It is expected that this concept realization will support the development of the local economy and will serve as an example of sustainable development in offshore environments. Furthermore it will provide further opportunities in the field of “blue” economy for Taiwan.

The platform is estimated to have a production capacity of approximately 5 MW net which will be provided by 2 OTEC turbine-generators. The platform internal need is estimated to 1MW max. Algae and aquaculture modules aim at producing 3000-4500t of fish on two years production cycle and 110t of algae per year. The biomass transformation will be performed on board with the following ratios 30% fresh fish and 70% byproducts. The processing plant is designed to work 1-5 days/month with a capacity of 50-100t/day. The exportation and importation will be done one to five transports per month. It will export 110t fishes and per rotation max, and import 23t per rotation max. All wastewater and solid waste produced on the platform will be stored and treated on board of the central unit. Wastewater is stored in tanks and will be treated and purified following best practice in a septic plant before being dumped. Solid waste will be either burned in a high quality incinerator or, in the case of plastic, glass, cans, they will be compacted and transported to shore.

2 METHODOLOGY

Random Utility theory is the basis for the CE developed in this document. It is considered that the utility U_{ij} of a given alternative j for an individual i is a function of the attributes Z_j of alternative j and of individual features S_i:

$$U_{ij} = V_{ij}\left(Z_j, S_i\right) + \varepsilon_{ij} \qquad (1)$$

Where $V_{ij}\left(Z_j, S_i\right)$ is an observable component and ε_{ij} is a stochastic element. A second utility relation links the probability of an outcome to the utility of each alternative. That is, individuals are assumed to choose the alternative yielding the highest utility:

$$Pr_{ij}\left(j|Z_j, Z_k, S_i\right) = \Pr\left[\left(V_{ij} + \varepsilon_{ij}\right) > \left(V_{ik} + \varepsilon_{ik}\right)\right], \quad \forall \ j \neq k \qquad (2)$$

and

$$Pr_{ij}\left(j|Z_j, Z_k, S_i\right) = \Pr\left[\left(V_{ij} + V_{ik}\right) > \left(\varepsilon_{ik} + \varepsilon_{ij}\right)\right], \quad \forall \ j \neq k \qquad (3)$$

Suppose that we have data on n sets of observations $\left(\mathrm{Y}_i, X_{1i}, ...X_{ki}\right), i = 1, ...n$, where Y is an ordinal response variable with C categories labeled from lowest to the highest as $j = 1, ..., C$ and $X_1, ...X_k$ are explanatory variables. The ordinal logistic model is defined by the following assumptions:

- Observations Y_i are statistically independent of each other.
- Observations Y_i are random sample from a population where Y_i has a multinomial distribution with probability parameters $\pi_i^{(1)}, \pi_i^{(2)}, ..., \pi^{(C)}{}_i$, and thus with the cumulative probabilities

  $$\gamma_i^{(j)} = P\left(Y_i \leq j\right) = \pi_i^{(1)} + ... + \pi^{(j)}{}_i \qquad (4)$$

  For $j = 1, ..., C$ where $\gamma_i^{(C)}$ is equal to 1 for all i and thus need not be modeled separately

- The log odds based on the cumulative probabilities depend on the explanatory variables through

  $$\log\left(\frac{\gamma^{(j)}{}_i}{1-\gamma^{(j)}{}_i}\right) = \log\left(\frac{P\left(Y_i \leq j\right)}{P\left(Y_i \succ j\right)}\right) = a^i - \left(\beta_1 \mathrm{X}_{1i} + ...\beta_k X_{ki}\right) \ (5)$$

for each $j = 1, ..., C-1$ where $a^{(1)}, ...a^{(C-1)}$ and $\beta_1, ..., \beta_\kappa$ are unknown population parameters.

It has to be mentioned that in ordinal logistic model each explanatory variable has only one regression coefficient which applies to the models for each of the cumulative probabilities $\gamma_i^{(1)},.......,\gamma_i^{(C-1)}$ and that intercept terms $a_i^{(1)},.......,a_i^{(C-1)}$ must be ordered in size so that $a^{(1)} \leq a^{(2)} \leq .... \leq a^{(C-1)}$.

The ordinal logistic model can also be thought of as a set of binary models for sets of dichotomous responses obtained by combining adjacent categories of Y. j. Also we can define a binary logistic model for each of these new dichotomous variables. The formula for cumulative probabilities from the ordinal logistic model is

$$\gamma^{(j)} = P(Y \leq j) = \frac{\exp\left[a^{(j)} - (\beta_1 X_1 + ...\beta_k X_k)\right]}{1+\exp\left[a^{(j)} - (\beta_1 X_1 + ...\beta_k X_k)\right]} \qquad (6)$$

for each $j = 1,.........C-1$

3 DATA AND SAMPLE SIZE

The dataset consists of the results of a CE that took place in November 2014 by trained interviewers from the National Sun Yat-sen University. The population sampling was estimated using 2012 Census data. The calculation of the sample size (with a 95% confidence level and 5% confidence interval) was calculated using the following formula:

$$SS = \frac{Z^2(p)(1-p)}{c^2} \qquad (6)$$

where Z is the Z value, p is the percentage of picking a choice expressed as decimal, c is the confidence interval, expressed as decimal. The sie of the target population was 43,981 (local population and tourists). With a 95% confidence level, and a 5% confidence interval, the required sample size was estimated to be 381 respondents. Using stratified sampling the number of questionnaires required for each of the two categories estimated to be: 273 questionnaires implemented on respondents classified as tourists, 108 questionnaires implemented on respondents classified as local residents. Additionally, the sampling methodology required specific number of responses of local residents from each of the 8 districts of the area (Annex A)

4 QUESTIONNAIRE DESIGN AND SURVEY DESCRIPTION

As previously explained, the CEM is used in order to elicit the total economic value of non-market goods. Lancaster (1966), explains that any good can be described in terms of its attributes and their levels. Experimental design theory is used to generate different profiles of the public good in terms of its attributes and their levels. These profiles are then assembled in choice sets, which are presented to the respondents, who are asked to state their preferences.

The design of the survey followed the standard five steps for a CE: selection of desired attributes, definition of levels, choice of the experimental design, construction of choice cards to present to respondents and measurement of preferences.For this survey, the choice sets generated by combining the different levels of three attributes. These combinations describe the claimed impacts of the platform on employment and the environment and two different levels of mitigation options and conservation programs. The third part consists of follow up questions. The four attributes are:

1. Aquaculture facilities. Aquaculture facilities include fish and algae production. To reduce or avoid potential negative impacts of platforms on the environment, two mitigation levels were considered:

1. Mitigation options and conservation programs with some limitations. These mitigation options will have an acceptable reduction on environmental impacts.
2. Optimal mitigation options and conservation programs. These mitigation options will have optimal mitigation options and conservation programs and high visitor satisfaction.

2. Renewable Energy and Leisure Facilities. The Green & Blue concept in Taiwan is planned to include a floating Closed-Cycle OTEC plant. To reduce or avoid potential negative impacts of the platforms on the environment two mitigation levels were considered:

1. Mitigation options and conservation programs with some limitations. These mitigation options will have an acceptable reduction on environmental impacts.
2. Optimal mitigation options and conservation programs. These mitigation options will have optimal mitigation options and conservation programs and high visitor satisfaction.

3. Payment vehicle. This is the only attribute that changes between resident's and tourists' questionnaires. For residents, the scenarios proposed a local tax increase (absolute value per year). This monetary attribute is the respondents' contribution to the proposed design for mitigating pollution in order to have a sustainable growth model. It takes the form of a willingness to pay to avoid environmental damage. In the present application, the WTP was chosen because tax increases are more plausible than tax reductions (compensation for damages). This attribute has five levels: a) 0 euro per year (status quo); b) 10 euros per year; c) 20 euros per year; d) 30 euros per year; e) 40 euro per year. For tourists, the attribute took the form of a daily tourist tax that is, an increase of the cost of their holiday in Liuqiu Island per day. The levels for this attribute were set to: a) 0 euro per day (status quo); b) 2 euros per day; c) 4 euros per day; d) 6 euros per day and e) 8 euro per day. In order to elicit stakeholder preferences for alternative two MUOPs designs were selected:**Design 1.** Aquaculture facilities (fish + algae) and **Design 2.** Aquaculture facilities+ Renewable energy+ Leisure facilities. Two levels of mitigation impacts: 1) Optimal and 2) Acceptable.

For the construction of the design of the questionnaire, the package support.CEs (Aizaki 2012) was used.[1] The software creates CE designs based on orthogonal main-effects arrays. The method used by the program uses the orthogonal main effect array as the first alternative in each choice set. This process creates alternatives by adding a constant to the attributes of the first alternative. The process is followed by the randomization of the order of the alternatives and the construction of the choice sets. The result of this procedure is the construction of a generic form of the questionnaire that can be used for the survey. The combination of the aforementioned levels produce a full factorial design that was reduced in order to produce 12 choice set groups (see Annex II). The reason is that some of the lacked of economic sense. Such choice sets were those that contained one alternative with lower levels of the attributes but higher prices than another alternative with higher level of attributes at a lower price in the same choice card. Therefore, the 12 choice cards selected for the survey had 3 alternatives each. Alternative A and B concerned two hypothetical changes in the circumstances, whereas the alternative C denoted the *status quo* (no platform is installed), each card contains visual images in order to convey the different attributes and levels explained to respondents and correspond with the effects on the environment, mitigation options and taxes. Finally, two follow-up questions were included. The first was designed to understand the reasons that affected the way the interviewees made their choices and distinguishes between costs, improvements in the environment, job creation and impacts on the GDP and the inclusion of renewable energy and leisure facilities.

5 ANALYSIS

The aim of this section is to provide an econometric analysis of the dataset produced for the CE using the questionnaire presented in following sections.

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[1]Aizaki H (2012). support.CEs: Basic Functions for Supporting an Implementation of Choice Experiments. R package version 0.2-4, URL http://CRAN.R-project.org/package=support.CEs.

5.1 Residents Analysis

The first part of this analysis aims to elicit the residents' preferences for the 2 proposed designs. The answers of thirty-four residents' questionnaires were included in the analysis. Each of the thirty-four interviewees were shown 12 choice cards and were asked to rank their most and least preferred design option that allowed us to do the following ranking: 1st=most preferred, 2nd=residual, 3rd=least preferred. Thus, 1,224 observations in total are possible. However, the final dataset had missing observations. Table 2 presents a cross-tabulation of the preferences stated by the interviewees and platform design. From this table it is evident that the most preferred option for the residents is to maintain the Status Quo (i.e. no platform is installed). Seventy two percent of the respondents chose this option as their most preferred. On the other hand, design two (aquaculture, renewable energy and leisure facilities) was the least preferred option. Sixty five percent of the respondents stated that this was their least preferred option.

Table 2 Cross-tabulation of residents' ranked preferences and platform design

*Key
frequency
row percentage

		Design		
Rank	Status Quo	Design 1	Design 2	Total
1st	282	29	76	387
	72.87	7.49	19.64	100
2nd	49	121	217	387
	12.66	31.27	56.07	100
3rd	57	76	255	388
	14.69	19.59	65.72	100

Total	388	226	548	1,162
	33.39	19.45	47.16	100

Pearson chi2(4) = 424.3162 Pr = 0.000

Since the chi-squared value is significant, we could claim that there is a relationship between the stated rank preference and the design option. Nevertheless, we can only claim that the distributions are different because the chi-squared test is not directional. One way to model these data is to model the categorization that took place when the data were created. We estimate an ordered logistic model where the ranking preference is explained by the design options (see Table 3). In the table we see the coefficients, z-tests and their associated p-values. Both coefficients are statistically significant. Further, we can expect a negative change of 89% in the odds of design 1 to be selected as the most preferred option and a negative change of 92% in the odds of design 2 to be selected as the most preferred option. In other words, it is not very likely that Design 1 or 2 could be chosen as the most preferred option.

Table 3 Estimated regression coefficients for residents' ordinal logistic model (dep. variable=stated design preference)

design	b	z	P>|z|	%	%StdX	SDofX
Design 1	-2.207	-12.877	0.000	-89.00	-58.3	0.396
Design 2	-2.539	-16.890	0.000	-92.10	-71.9	0.499

b = raw coefficient

z = z-score for test of b=0

P>|z| = p-value for z-test

% = percent change in odds for unit increase in X

%StdX = percent change in odds for SD increase in X

SDofX = standard deviation of X

Table 4 presents the estimated fractions of stated preference and design option using the cross-tabulation values and the predicted values using the estimated ordinal logistic model coefficients. Note that the predicted fractions confirm that the most preferred option is to maintain the status quo followed by the design 1 and the least preferred option is design 2.

Table 4 Predicted fractions of residents' preferred design using cross-tabulation values and the estimated ordinal logistic model coefficients

	Tabulate			**Logit**		
Rank	Status Quo	Design 1	Design 2	Status Quo	Design 1	Design 2
1st	0.727	0.128	0.139	0.701	0.205	0.156
2nd	0.126	0.535	0.396	0.232	0.400	0.368
3rd	0.147	0.336	0.465	0.067	0.395	0.476

After the choice experiment was conducted, the interviewees were asked if they would support or oppose the initiative if the construction of the platform was approved. The results presented in **Error! Reference source not found.** are in line with the previous results. 67.74% of the respondents stated that they would oppose the initiative.

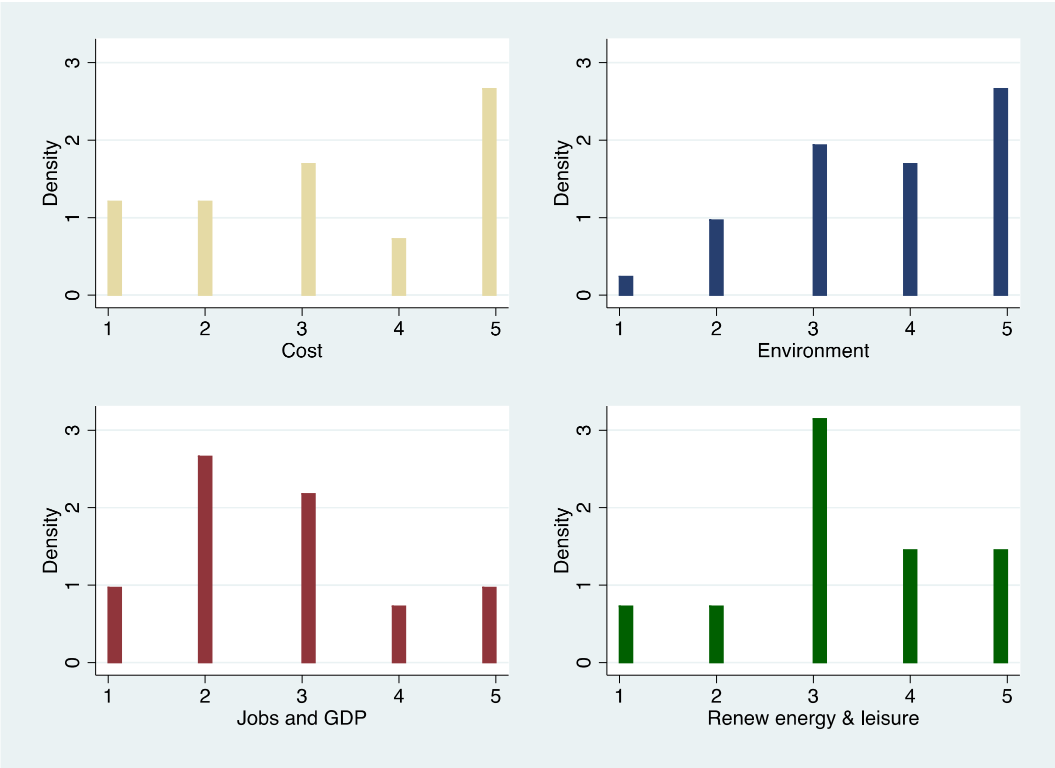
Table 5 Answer to the question "if the construction of the platform was approved you will.."

Answer	**Percent**	**Cummulative**
Oppose	67.74	67.74
Support	32.26	100
Total	100	

As a follow-up question, the interviewees were enquired about the reasons affecting their choice cards preferences. Four alternatives were provided: 1) The height of cost, 2) Improvements in the Environment, 3) Job Creation and impacts on the GDP and 4) Renewable energy and leisure facilities. The possible answer was a Likert type variable where: 1-Not at all, 2-Very little, 3-Moderately, 4-Enough and 5-Very much.

Figure 2 presents a combined graph of the histograms for each of the alternatives and the densities of response. In general, cost and environment related alternatives were reasons that affected in a high degree the stated preferences. The presence of energy and leisure facilities was a reason that affected moderately the preference and GDP impacts and Job creation were not deemed very important factors when the preference was stated.

Figure 2 Histograms for the residents' reasons affecting the choice card preferences



In the final part of the analysis we aim to elicit respondents' preferences for the different levels offered in each attribute of the designs. Therefore, we estimate a model (see Table 6) with the stated preference as dependent variable and the different attributes' levels as independent variables. These are dummy variables for environmental mitigation that take the value of one if the design offers either acceptable or optimal mitigation and zero otherwise. In consequence, for a one unit increase in acceptable environmental mitigation (i.e., going from 0 to 1) for design 1 (D1), the odds of selecting this design as the most preferred versus the combined and best and least preferred categories are 0.121 lower. The difference with an optimal mitigation is marginal, the odds of selecting this level as the most preferred are 0.120 lower. On the other hand, a one unit increase in acceptable environmental mitigation for design 2 (D2), the odds of selecting this design as the most preferred versus the combined and best and least preferred categories are 0.753 lower. The odds of selecting an optimal mitigation as the most preferred option are 0.690 lower. These results confirm that D1 is preferred over D2 and that an optimal environmental mitigation is preferred over an acceptable mitigation (although marginally in the case of D1). Finally, in terms of the tax, the sign indicates that the higher the tax, the less likely that the option will be selected as the most preferred. Nevertheless, given that the coefficient of the bid is not statistically significant it is not possible to estimate the monetary value of the costs implied to the residents for the installation of the different platforms or the willingness to pay form improvements on the environmental mitigation.

Table 6 Estimated regression coefficients for ordinal logistic model at different levels of mitigation (dep. variable=stated design preference)

design	b	z	P>|z|	e^b	e^bStdX	SDofX
D1 accept	-2.1143	-9.158	0.000	0.121	0.348	0.499
D1 opt.	-2.1166	-8.663	0.000	0.120	0.433	0.396
D2 accept	-0.2839	-1.750	0.08	0.753	0.884	0.433
D2 opt.	-0.3703	-2.060	0.039	0.690	0.857	0.416
Tax	-0.0001	-0.649	0.517	1.000	0.943	625.451
b = raw coefficient						
z = z-score for test of b=0						
P>|z| = p-value for z-test						
e^b = exp(b) = factor change in odds for unit increase in X						
e^bStdX = exp(b*SD of X) = change in odds for SD increase in X						
SDofX = standard deviation of X						

Finally, a number of Wald tests were conducted in order to investigate whether various demographic and socio-economic characteristics affect the attitude of respondents towards the attributes considered. The results of the tests are presented in Table 7. Under the null hypothesis, there is no difference in the behaviour of groups of respondents with different characteristics. We first examine whether gender has an effect on the stated preferences. The results indicate that gender affects the estimated coefficients of all the attributes. Then we analyse if education level affects the preferences. The results show no differences bewteen respondents with different levels of education. Finally, we assessed the effect of different levels of income on preferences. There is evidence that respondents with different levels of income have different attitude towards D1 and not surprisingly to the cost of the platforms.

Table 7 Effects of residents' socio-economic characteristics on the stated preferences

	Gender	
	Wald Statistic	p-value
All attributes	17.7	0.0033
Env. Mitigation D1	13.59	0.0011
Env. Mitigation D2	13.82	0.001
Cost	6.22	0.0126
	Education	
	Wald Statistic	p-value
All attributes	3.47	0.628
Env. Mitigation D1	2.21	0.3304
Env. Mitigation D2	1.76	0.4154
Cost	1.64	0.201
	Income	
	Wald Statistic	p-value
All attributes	6.15	0.2919
Env. Mitigation D1	5.21	0.0739
Env. Mitigation D2	3.5	0.1737
Cost	4.96	0.026

5.2 Tourists Analysis

This section aims to elicit tourists' preferences for the 2 proposed designs. The answers of 118 tourists' questionnaires were included in the analysis. As in the case of residents, each of the interviewees were shown 12 choice cards and were asked to rank their most and least preferred design option that allowed us to order the preferences as in the previous section. Thus, 4,248 observations in total are possible but the final dataset has missing observations as well. Table 8 presents a cross-tabulation of the preferences stated by the interviewees and platform design. It is interesting to the most frequent preferred option is also to maintain the Status Quo (41.18%). However, the second most frequent preferred option is design 2 that includes leisure facilities (40.96%). Note that the percentages are very close. Nevertheless, we have to be cautious with the results since D2 was also the most frequent least preferred option. Since the chi-squared value is significant, we could claim that there is a relationship between the stated rank preference and the design option.

Table 8 Cross-tabulation of tourists ranked preferences and platform design

		Design		
Rank	Status Quo	Design 1	Design 2	Total
1st	572	248	569	1,389
	41.18	17.85	40.96	100
2nd	491	314	575	1,380
	35.58	22.75	41.67	100
3rd	318	361	704	1,383
	22.99	26.1	50.9	100
Total	1,381	923	1,848	4,152
	33.26	22.23	44.51	100
Pearson chi2(4) = 112.8524 Pr = 0.000				

We estimate an ordered logistic model where the ranking preference is explained by the design options (see Table 9). These are dummy variables that take the value of one if the design is offered and zero otherwise. In the table we see the coefficients, z-tests and their associated p-values. Both coefficients are statistically significant. In consequence, for a one unit increase in the design (i.e., going from 0 to 1) the odds of selecting this design as the most preferred versus the combined second best and least preferred categories are 0.503 lower for D1 and 0.561 lower for D2.

Table 9 Estimated regression coefficients for tourists' ordinal logistic model (dep. variable=stated design preference)

design	b	z	P>|z|	e^b	e^bStdX	SDofX
Design 1	-0.6866	-8.747	0.000	0.503	0.752	0.416
Design 2	-0.5789	-8.782	0.000	0.561	0.75	0.497
b = raw coefficient						
z = z-score for test of b=0						
P>|z| = p-value for z-test						
e^b = exp(b) = factor change in odds for unit increase in X						
e^bStdX = exp(b*SD of X) = change in odds for SD increase in X						
SDofX = standard deviation of X						

Table 10 presents the estimated fractions of stated preference and design option using the cross-tabulation values and the predicted values using the estimated ordinal logistic model coefficients. Note that the predicted fractions confirm that the most preferred option is to maintain the status quo followed by D2 (design with leisure facilities) and D1 respectively.

Table 10 Predicted fractions of tourists' preferred design using cross-tabulation values and the estimated ordinal logistic model coefficients

	Tabulate			**Logit**		
Rank	Status Quo	Design 1	Design 2	Status Quo	Design 1	Design 2
1st	0.414	0.269	0.308	0.4267776	0.272565	0.294447
2nd	0.356	0.340	0.311	0.3264181	0.333092	0.3366341

3rd	0.230	0.391	0.381	0.2468042	0.394343	0.368919

The results of the follow up question “would you support or oppose the initiative if the construction of the platform was approved?” indicate that 69.81% of the respondents stated that they would support the initiative.

Table 11 Answer to the question “If the construction of the platform was approved you will…”

Answer	**Percent**	**Cum.**
Oppose	17.29	17.29
Support	69.81	87.1
No Answer	12.9	100
Total	100	

In the final part of the analysis we aim to elicit tourists’ preferences for the different levels offered in each attribute of the designs. A model is estimated (see table Table 12) with the stated preference as dependent variable and the different attributes’ levels as independent variables. These are dummy variables for environmental mitigation that take the value of one if the design offers either acceptable or optimal mitigation and zero otherwise. In consequence, for a one unit increase in acceptable environmental mitigation (i.e., going from 0 to 1) for design 1 (D1), the odds of selecting this design as the most preferred versus the combined and best and least preferred categories are 0.506 lower and for an optimal mitigation the odds of selecting this level as the most preferred are 0.545 lower. On the other hand, a one unit increase in acceptable environmental mitigation for design 2 (D2), the odds of selecting this design as the most preferred versus the combined and best and least preferred categories are 1.272 higher. The odds of selecting an optimal mitigation as the most preferred option are 1.040 higher but the coefficient is not statistically significant. These results confirm that D2 is preferred over D1 and this could be explained due to the fact that D2 offers leisure facilities that could be used by the tourists. Finally, in terms of the tax, the sign indicates that the higher the tax, the less likely that the option will be selected as the most preferred.

Table 12 Estimated regression coefficients for tourists' ordinal logistic model at different levels of mitigation (dep. variable=stated design preference)

design	b	z	P>|z|	e^b	e^bStdX	SDofX
D1 accept	-6.537	-5.855	0.000	0.506	0.711	0.499
D1 opt.	-0.608	-5.067	0.000	0.545	0.786	0.397
D2 accept	0.2408	2.708	0.007	1.272	1.105	0.415
D2 opt.	0.0396	0.412	0.681	1.040	1.017	0.417
Tax	-0.0004	-0.545	0.586	1.000	0.974	62.698
b = raw coefficient						
z = z-score for test of b=0						
P>|z| = p-value for z-test						
e^b = exp(b) = factor change in odds for unit increase in X						
e^bStdX = exp(b*SD of X) = change in odds for SD increase in X						
SDofX = standard deviation of X						

Given that the coefficient of the bid is not statistically significant for this model it is not possible to estimate the monetary value of the costs implied to the residents for the installation of the different platforms or the willingness to pay form improvements on the environmental mitigation. However, an additional model was estimated in order to elicit willingness to pay for the attributes. In this model, the stated preference is the dependent variable and the two designs with an acceptable environmental mitigation level and the bid are the independent variables. The results confirm that tourists prefer D2 over D1 (see Table 13). The estimated willingness to pay for each design is presented in table 12. The results indicate that there is a negative willingness to pay for D1 of 86.5 NT$, meaning that the development of the aquaculture facilities only has a negative impact on their utility. On the other hand, if renewable energy and leisure facilities are also developed the estimated willingness to pay for a tax per day is 53.66 NT$.

Table 13 Estimated regression coefficients for tourists' ordinal logistic model at acceptable level of mitigation (dep. variable=stated design preference)

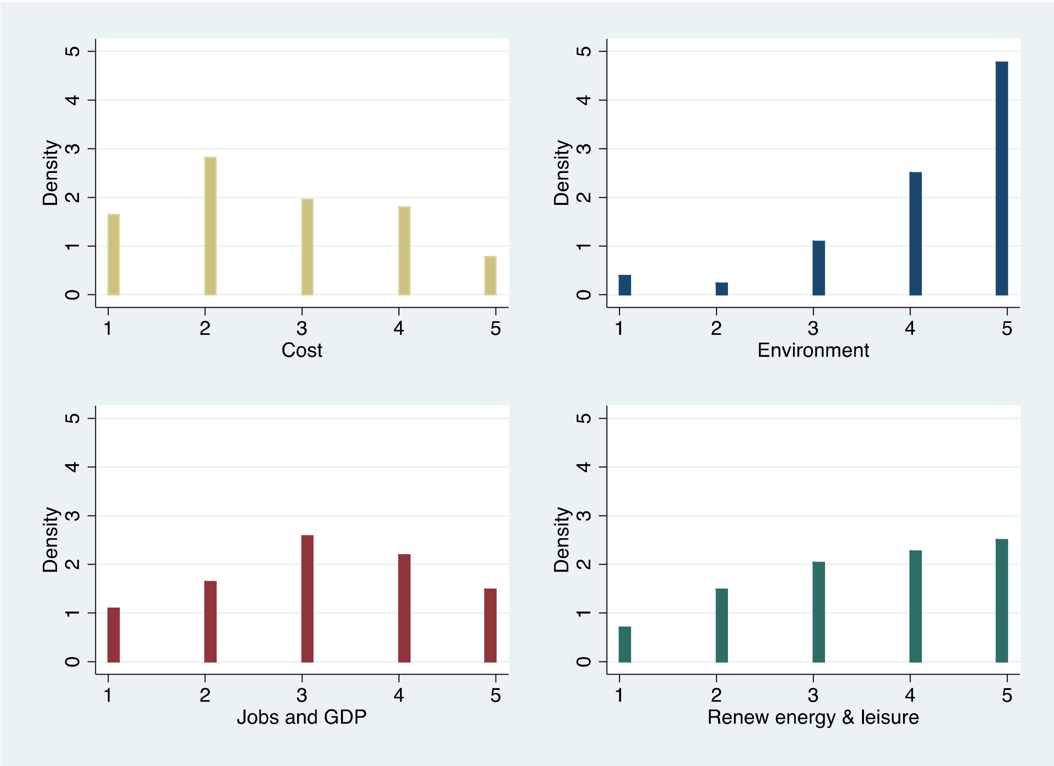
design	b	z	P>|z|	e^b	e^bStdX	SDofX
D1 accept	-4.120	-3.858	0.000	0.769	0.877	0.499
D2 accept	0.163	2.143	0.032	1.176	1.070	0.415
Tax	-0.003	-5.242	0.000	0.997	0.827	62.698
b = raw coefficient						
z = z-score for test of b=0						
P>|z| = p-value for z-test						
e^b = exp(b) = factor change in odds for unit increase in X						
e^bStdX = exp(b*SD of X) = change in odds for SD increase in X						
SDofX = standard deviation of X						

Table 14 Estimated willingness to pay for D1 and D2 with acceptable environmental mitigation level

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
WTP	-86.5176	33.9347	-2.55	0.011	-153.0284	-20.00681
WTP	53.66313	23.56276	2.28	0.023	7.480966	99.8453

In a follow-up question, the interviewees were enquired about the reasons affecting their choice cards preferences. Figure 3 presents a combined graph of the histograms for each of the alternatives and the densities of response. In general, we can identify environmental considerations as important reasons that affected the stated preferences followed by the presence of renewable energy and leisure facilities in the platform. GDP impacts and Job creation and cost are factors that the respondents consider that affected moderately their stated preferences.

Figure 3 Histograms for the tourists' reasons affecting the choice card preferences



Finally, a number of Wald tests were conducted in order to investigate whether various demographic and socio-economic characteristics affect the attitude of respondents towards the attributes considered. The results of the tests are presented in Table 15. Under the null hypothesis, there is no difference in the behaviour of groups of respondents with different characteristics. We first examine whether gender has an effect on the stated preferences. The results indicate that both gender and education level of the respondent affects the estimated coefficients of all the attributes. Finally, we assessed the effect of different levels of income on preferences. There is no evidence that respondents with different levels of income have different attitude towards the designs and not surprisingly to the cost of the platforms.

Table 15 Effects of tourists' socio-economic characteristics on the stated preferences

	Wald Statistic	p-value
All attributes	10.73	0.057
Env. Mitigation D1	9.75	0.0076
Env. Mitigation D2	9.46	0.0088
Cost	7.69	0.0056
	Education	
	Wald Statistic	p-value
All attributes	57.72	0.0000
Env. Mitigation D1	45.84	0.0000
Env. Mitigation D2	39.85	0.0000
Cost	26.23	0.0000
	Income	
	Wald Statistic	p-value
All attributes	3.11	0.6835
Env. Mitigation D1	2.05	0.3596
Env. Mitigation D2	2.41	0.2991
Cost	2	0.1573

6 Conclusions

In conclusion, two thirds of the residents stated that they would oppose the development of the platform. Nevertheless, there is one third that would support its development. The results suggest that aquaculture facilities may be more appealing for the residents than a combined option. A tax increase in order to mitigate environmental impacts of the platform development would be opposed by the majority. Therefore it is suggested that future research includes focus groups in order to understand in depth the environmental and economic concerns of the local population and more detailed research on the costs and alternatives of mitigation options are required in order to estimate more accurate economic instruments designed to deal with the environmental impacts. On the other hand, tourists are more likely to support the development of the platform (around 70% stated that they would support the development) but only if the design includes leisure and renewable energy facilities. The results indicate that the tourists are not favourable to a design that only includes aquaculture facilities. However, they are willing to pay a tax of 53.66 NT$ per day in order to enjoy the proposed leisure and renewable energy facilities with acceptable environmental mitigation options.

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ANNEX A

The local population is distributed among eight districts. The following table presents the number of questionnaires required per district.

Table 4.Number of questionnaires required per district

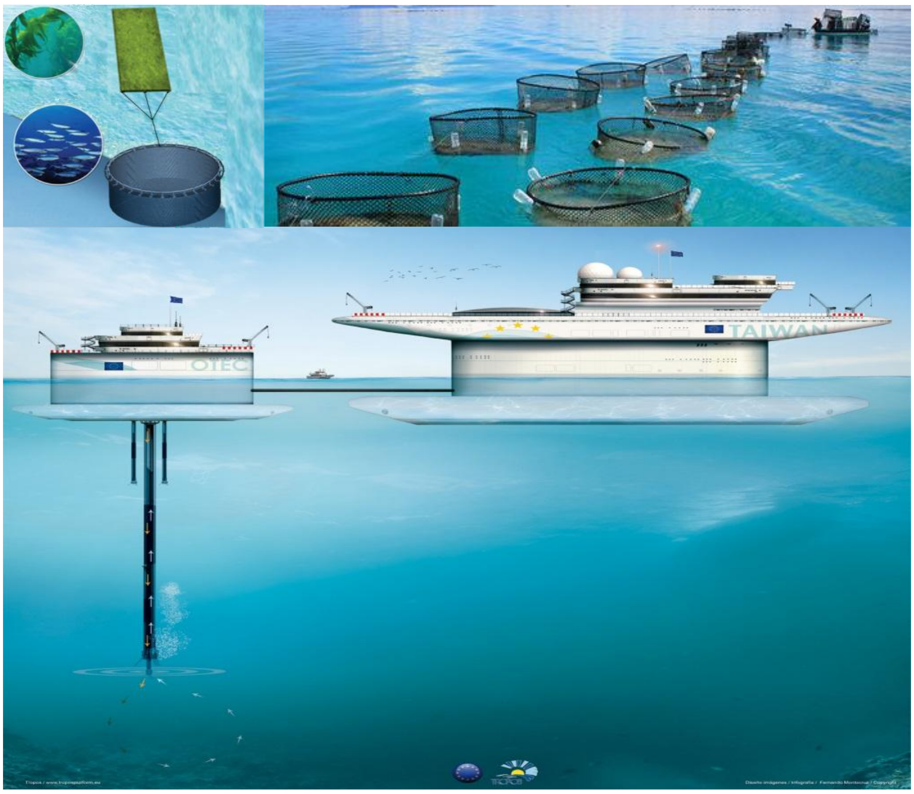
Sector	**Percentage of Population in the district**	**Number of questionnaires required per district**
1	16%	17.28
2	16%	17.28
3	11%	11.88
4	10%	10.8
5	20%	21.6
6	7%	7.56
7	11%	11.88
8	9%	9.72
Total	**100%**	**108**

ANNEX B

Design 1. Aquaculture Facilities

Attributes	Description and economic impacts	Environmental Impacts	Levels
Design 1: Aquaculture Facilities (Fish+Algae): Satellite Unit (not inside the platform)	Fish and Algae Aquaculture: 1,333 FTE positions and GDP impact of NT$ 1,660 million (€43.35 million)	**Solid and liquid wastes:** Major effect on water and sediment quality, benthos, fish and turtles, marine mammals and humans **Noise and vibrations:** fish and turtles and marine mammals, the mooring will significantly affect sediment dynamics. **Artificial lighting of the fish farm units:** pose a major impact on marine mammals, birds and bats, and fish and turtles. **Escape of fish from the fish cages and the introduction of alien species:** major impact for plankton, benthos, and fish and turtles	1 Acceptable reduction on environmental impacts 2 Optimal levels of conservation and high visitor satisfaction

Design 2. Aquaculture Facilities + Renewable Energy: OTEC plant + Leisure Facilities



Attributes	Description and economic impacts	Environmental impacts	Mitigation levels
Design 2: Aquaculture Facilities (Fish+Algae): Satellite Unit (not inside the platform)+ +Renewable Energy: OTEC plant not inside the platform +Leisure Facilities (Accommodation +Food and Beverage)	Fish and Algae Aquaculture: 1,333 FTE positions and GDP impact of NT$ 1,660 million (€43.35 million)	**Solid and liquid wastes:** Major effect on water and sediment quality, benthos, fish and turtles, marine mammals and humans **Noise and vibrations:** fish and turtles and marine mammals, the mooring will significantly affect sediment dynamics. **Artificial lighting of the fish farm units:** pose a major impact on marine mammals, birds and bats, and fish and turtles. **Escape of fish from the fish cages and the introduction of alien species:** major impact for plankton, benthos, and fish and turtles	1 Acceptable reduction on environmental impacts 2 Optimal levels of conservation and high visitor
	Renewable Energy +	**Heat energy:** major effect on water temperature and the pelagic flora and fauna.	

	Accommodation, restaurant, sky lounge, garden and store		satisfaction