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Estimating Total Economic Value of Coral Reefs of Kish Island (Persian Gulf)

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ABSTRACT: This paper is concerned with the economic valuation of the coral reef within Kish Island in Persian Gulf of Iran. For calculating this value, all components of use and non-use values are estimated and then according to each of them, suitable method has applied. Many different evaluation tools such as contingent valuation method, zonal travel cost method, replacement cost, avoided cost method, value at risk method are used. The semi non parametric distribution free estimator for calculating the contingent valuation method is applied. The probability of willingness to pay the same as the probability of accepting bids is estimated by using data based on questioners approach using stated preference method. The result indicates that the total economic value of this unique ecosystem in Kish Island is at least 14.6 million dollar per year, showing the importance of conservation value of the ecosystem. Its largest component of total economic value is about 62 percent attributed to the recreational value. This is followed by conservation value which is about 23 percent of the economic value. Since coastal protection and waste assimilation functions of coral reef are 10 percent, it is also suitable factor in illustrating total economic value. The economic value for each hectare of this ecosystem in Kish Island is US$ 237,000 in 2009.

Key words: Fourier functional form, TEV of Coral reef, CV method, SNPDF estimator, EWTP, Persian Gulf, Iran

INTRODUCTION

Coral reefs are a valued natural resource because they support the variety of benefits streams that involve cultural, social, biological, and economic values. The economic benefits that come from reef ecosystems accrue to local economies and citizens around the globe (Pendleton 1995).

Coral reefs ecosystem is characterized as the most productive and high biodiversity marine ecosystem in the world (Moberg and Folke 1999, Cesar 2000). There are many reasons why the economic valuation of ecosystems, such as coral reefs, is important (Bhatnagar and Singh, 2010; Dehghani *et al.*, 2010; Vicente and Crezo, 2010; Ezebilo, 2010; Zagas *et al.*, 2010; Monavari *et al.*, 2010; Ehsani and Quiel, 2010). First, economic valuation estimates the full range of benefits provided by an ecosystem, representing an indicator of the importance of the ecosystem to society. Second, it evaluates the costs and benefits of different management options, including conservation and helping policy decision makers. Third, valuation plays an important role in determination of the appropriate fees and taxes to impose on individuals or firms causing negative externalities impacts on the ecosystem. Finally, economic valuation can be used for advocacy purposes, for helping policy-makers to set up the efficient and equitable decisions regarding resource use and its management.

Goods and services provided by coral reefs ecosystem such as fishing, aquaculture, tourism, costal protection, aesthetic and cultural values generate sources of income for communities around the reef areas. The benefits of coral reefs have evaluated in terms of money, showing their potential net benefit estimation of about 29.8 billion United State dollar (Cesar, Burke and Pet-Soede, 2003).

Efforts to assess the monetary value of ecosystem services play multiple roles in managing the links between human and natural systems. At the micro-level, valuation studies reveal information on both the structure and functioning of ecosystems and their roles in supporting human welfare. At the macro-level, ecosystem valuation contributes to the construction of indicators of human welfare and sustainability (Howarth and Farber, 2002).

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The total economic value (TEV) of a natural resource like the coral reef is the sum of its use and non-use values. Use values relate to actual use, planned or possible use of the goods and services (Bateman *et al.,* 2002) which are divided into direct as well as indirect uses. Direct uses can be either extractive like reef fisheries, or non-extractive like ecotourism and recreation activities. Indirect uses of the ecosystem services support and protect the other economic activities, representing the nutrient cycling or biodiversity maintenance. Option values describe the benefit gained from preserving and maintaining the option to use the resource in the future which are sometimes categorized as use values (Bateman *et al.,* 2002) and sometimes as non-use values (Cesar, 2000). Potential option values exist for coral reefs, like organisms which contain bioactive compounds, having large financial value for pharmaceutical products in the future.

Non-use values have two frequently recognized elements, existence value relates to the utility gained from knowing that something exists without any intention to visit or to use the resource, whereas the bequest value shows the satisfaction gained from preserving the resource passed to future generations (Spurgeon 1992).

Costanza *et al.,* in 1997 was estimated the total economic value of the world's ecosystems. Each ecosystem was broken down into its component of the goods and services and that their economic values were estimated using figures from a wide range of other studies. In their studies, the goods and services provided by coral reefs included: disturbance regulation, waste treatment, food production, raw materials and recreation. Each hectare produced annual services of $6,075 billion and annual global benefit of $375 billion. Their studies were criticized on the basis of the benefits transfer and aggregation techniques by Bockstael *et al.,* (2000) and by Toman (1998). White *et al.,* (2000) compared their own estimates of the economic value of coral reefs in the Philippines with estimates using reported by Costanza *et al.,* (1997).

Mohd-Swahwahid and McNally (2001) carried out a TEV study for all of Samoa's ecosystem resources, using the market prices to estimate the net value of the fishery; applying the contingent valuation method to determine the economic value regarding recreation and ecological functions of the marine environment; and employing the benefit transfer method to calculate the value of raw materials (without considering fish and shell fish) and cultural values concerning the marine resource. The TEV of the marine ecosystems to Samoan residents was estimated at ST$18,533,332 per year which the share of fisheries is about 84%. The global value was over 10 times greater at the amount around ST$225,982,083 than the value created through the ecological functions. In this study annual benefits were about 385 million US dollar and the discount rate assumed to be fixed at the rate of 3% over 50 years. Cesar *et al.,* (2000) determined the TEV of Hawaiian coral reefs around $9.7 billion, assuming no change from present state of coral reefs. White *et al.,* (2000) predicted the TEV of Philippine coral reefs, using economic values for fisheries (economic values of fisheries include local and sales as well as live export), tourism, coastal protection, and aesthetic and biodiversity services. They estimated that the TEV of Philippine coral reefs comes to US$1.35bn/yr, using only 50% in sustainable manner without destructive fishing.

Seenprachawong (2003) estimated the TEV of phi phi Island coral reefs in Thailand, showing the total economic value based on tourist valuation was about 15000 $ for each hectare. In this study the willingness to pay is the same for domestic and international tourist but the travel costs are different.

Most of the studies in Iran about coral reefs are form biological aspects and there is no study to evaluate the TEV of coral reefs of Persian Gulf in Iran, so this paper attempts to calculate this value. The paper is organized as follows. Section 2 deals with the introduction of the study area. An approach of semi-nonparametric distribution-free is introduced to form the expected willingness to pay distribution, replacing the linear utility difference with a Fourier flexible form in section 3. Total economic value of coral reefs of Kish Island is calculated in terms of all components of use and non use values in section 4. The final part of the paper concerns with the conclusion.

The coastline of Iran is 1880 km along the Persian Gulf and Gulf of Oman (McCoy 2002). Corals are mostly restricted to the offshore islands on the Persian Gulf coast of Iran. Kish is located in the Persian Gulf 19 km from mainland Iran and has an area of around 91 km² with an outer boundary of 40 km and a nearly elliptical shape. Along Kish's coasts there are coral reefs and many other small islands. Kish Island is one of the known coral rich areas, with 62 ha of coral reefs called Reef Check Site. Kish is a resort island in the Persian Gulf, as a part of the Hormozgan Province of Iran, and as a touted consumer's paradise since it is free trade zone status with tourist attractions. According to the Iran Travel and Tourism Forecast, Economist Intelligence Unit, in 2008 its estimated population is about 20,000 residents and its annual visitors are almost 1 million people. It is the third most visited vacation destination city in the Middle East, after Sharm el-Sheikh and Dubai (KFTZO, 2009).

The hard coral reef is located at South East corner of Kish Island, running parallel to the shore, rising from 6-7m to 2m below the surface separated by a narrow sandy strip. Fringing and patch reefs are the most types of coral reefs in Kish Island. Also it keeps large schools of snapper, goatfish, fusiliers and other tropical reef fishes and the occasional black tip reef sharks with lots of turtles, rays, moray eels, and shoal fish. There are 27 species include 9 families and 20 genera in the Kish and Island area with the most abundant families, being the Faviidae, Acroporidae and Poritidae (Wilkinson 2004).

The most important threat to Kish Island coral reef is oil pollution and coastal development which is human overused and natural induced resources. Bleaching is also degrading this habitat during 15 years. There are several categories of anthropogenic threats concerning coral reefs which extensively discussed in the edited volume by Salvat (1987) divided into local and global threats. At the local level, the main threats are: (i) destructive and non-sustainable fishery practices like poison fishing, blast fishing, muro-ami fishing among others; (ii) sedimentation, pollution, and waste; (iii) mining and dredging activities; and (iv) non-sustainable tourism practices (Cesar 2000). Currently, the main global threat is coral bleaching (Wilkinson *et al.,* 1999).

MATERIALS & METHODS

Suppose the individual indirect utility function define by u=u (q_0, y, x,ε) which q=1 if the improvement to environmental has occurred and q=0 otherwise. Income is denoted by y and other observable attributes of the individual which might affect his preferences (like age, sex, education, be a member of NGOs, etc) are shown by the vector x and e is unobservable taste parameters that have some distribution over the population of consumers. Here we suppose that q=1 might indicate a new program which improve the coral reef quality and q=0 otherwise (the following discussion borrows from Hanemann, 1984; and Creel and Loomis, 1997). According to q the individual's indirect utility function has two states. Let u_1=u (1, y, x,ε) be indirect utility in the state of improvement the quality of coral reefs (q=1) and let u_0=u (0, y, x,ε) be indirect utility without the program (q=0). A crucial assumption is that although the individual knows his utility function u=u (q, y, x) with certainty, it contains some components which are unobservable to the econometric investigator as stochastic, these leads to have a stochastic structure for statistical binary response model. Thus u_0 and u_1 are random variables with some given parametric probability distribution function with means v(0, y; x) and v(1, y; x) which depends on income and other variable such as personal characteristics, so that $u_1=v_1+\varepsilon_1$ and $u_0=v_0+\varepsilon_0$ where ε_1 and ε_0 are mean zero random variables.

When offered an amount of money, B$, to pay for improving the quality of coral reefs, the individual will accept the offer if $v(1, y-B, x) + \varepsilon_1 \geq v(0, y, x) + \varepsilon_0$ and refuse it otherwise. The individual knows for sure that which choice will maximize his utility and his response is a ransom variable with its probability is given by:

$$\Pr(\text{yes or accept the B}) = \Pr\{v(1, y-B, x) + \varepsilon_1 \geq v(0, y, x) + \varepsilon_0\}$$

Define $\varepsilon=\varepsilon_0-\varepsilon_1$ and let $F_\varepsilon(.)$ be the distribution function of econditional on the arguments of the utility differences. The willingness to accept probability may be written as Pr (yes) = $F_\varepsilon(\Delta v)$ where Dv= v (0, y, x) -v (1, y-B, x).

Compensating variation (CV) or WTP for the program is the quantity of payment by the consume such that utility after provision (u_1) is the same as utility in the base case (u_0), i. e. $v(1, y-CV, x) + \varepsilon_1 = v(0, y, x) + \varepsilon_0$. While the individual knows his own WTP (C_i), it is random variable with a given cumulative distribution function (cdf) denoted by G (C_i; θ) where θ represents the parameters of distribution which are to be estimated on the basis of responses to the CV survey. In OOHB format in which the respondent is presented with a range [B^L, B^U] where $B^L < B^U$. The corresponding response probabilities are as follow:

$$\Pr(\text{yes}) = \Pr(\text{yes, yes}) = \Pr\{C > B^U\} = 1 - \Pr\{C \leq B^U\} = 1 - G_C(B^U; \theta) \qquad (1a)$$

$$\Pr(\text{yes, no}) = \Pr(\text{no, yes}) = \Pr\{B^U \geq C \geq B^L\} = \Pr\{C \leq B^U\} - \Pr\{C \leq B^L\} = G_C(B^U; \theta) - G_C(B^L; \theta) \qquad (1b)$$

$$\Pr(\text{no}) = \Pr(\text{no, no}) = \Pr\{C \leq B^L\}\ G_C(B^L; \theta) \qquad (1c)$$

When ask of respondent to pay B$ for improving the quality of coral reefs, the individual will accept the offer if it be less than his maximum willingness to pay (B≤C) and refuse otherwise. Conditional mean compensating variation, E (CV|θ) is given by

$$E(CV|\theta) = \int_0^\infty G_C(B;\theta)\,dB \qquad (2)$$

In all cases, these conditional welfare measures are obtained as functions of the probability of acceptance of the bid amount, $F_\varepsilon(\Delta v)$. For consistent estimation of any of the welfare measure we need a consistent estimate of $F_\varepsilon(\Delta v)$. Separate specification and identification of the functions F_ε and Δv is an unnecessary complication that may lead to misspecification problems (Creel and Loomis, 1997).

For avoiding of this problem the semi-nonparametric distribution-free (SNPDF) approach is used and that it applied first to SB data by Creel and

Loomis (1997) and extended to DB and OOHB by Cooper *et al.*, (2002). The reason for the SNPDF approach is to reduce the sensitivity of our econometric analysis to specific parametric assumptions regarding the form of the WTP distribution (Creel and Loomis, 1997; Giraud, Loomis and Cooper, 2001).

The SNPDF approach suppose that the response probability has a logistic cdf e. g. $F(\Delta v)=[1+e^{-\Delta v}]^{-1}$ and $\Delta v= -\alpha + \beta B$, is what Hanemann (1984) calls a utility difference function, which is increasing in the bid price, B (in Cooper *et al.*, 2002). But replaces the linear utility difference with a Fourier flexible form (See Gallant, 1982) where omitting the quadratic term as in Creel and Loomis, 1997.

The SNPDF approach retains the logistic cdf in the response probabilities, but replaces the linear utility difference with a Fourier flexible form (e.g. Gallant, 1982).

$$\Delta V(x,\theta_K) = x\beta + \sum_{\alpha=1}^{A}\sum_{j=1}^{J}(u_{j\alpha}\cos[jk'_{\alpha}s(x)] - v_{j\alpha}\sin[jk'_{a}s(x)]) \quad (3)$$

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The vector x contains all arguments of the utility difference model, A and J are positive integers, and k_{α} are vectors of positive and negative integers that form indices in the conditioning variables, after shifting and scaling of x by s(x). There exists a coefficient vector such that, as the sample size becomes large, $\Delta(x)$ in (3) can be made arbitrarily close to a continuous unknown utility difference function for any value of x (Creel and Loomis, 1997).

The SNPDF specification here defines the set X= {AGE, EDUC, INC, BID}, or in abbreviated notation, X= {A, E, I, B}. The SNPDF utility difference is specified as:

$$\Delta V = x\beta + \sum_{x\in X}\beta_X \ln x + \sum_{x\in X} u_X \cos s_X(\ln x) + \sum_{x\in X} v_x \sin s_x(\ln x) \quad (4)$$

Here, the scaling functions $s_x(\ln x)$ shift and scale the (ln x) to lie in an interval of length less than 2π, for each $x\in X$. This is necessary to avoid periodicity of the model. The specific scaling function used for each variable (after taking logs) is to subtract the minimum, then divide by the maximum, so the scaled variable is in the [0, 1] interval. Next we multiply by 2π-0.00001, so the resulting final scaled variable is in the interval [0, 2π-0.00001], which satisfies the requirement (Creel and Loomis, 1997; Giraud, Loomis and Cooper, 2001; Cooper *et al.*, 2002).

RESULTS & DISCUSSION

The needed data are gathered from many different sources. To determine the sample size, the Cocran formula is applied and the number of 1661 households chosen for interviewing in all country to find the conservation value. In addition, for the reef visitors the number of 99 and 125 were randomly selected for diving and glass shipping respectively. Determining consumer surpluses, survey was carried out in tourists that come to visit the coral reefs in Kish Island. For conservation value, it was worked out for all households in Iran. The values measured consists of direct and indirect values as well as includes non-use values. Three kinds of direct use values are chosen for calculations like activities linked to fishing, recreating and doing potential researches.The first direct value is for fishing activity. Its data are published by Iranian Fisheries Research Organization, showing about 10 types of fish that are dependent on coral reef habitat and their dependency is about 50 percent. Their market value is calculated by having the price and the amount of fishing during year. There are some laws for aquarium trade that prevent fishermen to catch the ornamental fishes since they are valuable. By having the market prices and the number of each type of ornamental fishes, their market values are calculated which have been represented inTable 1.

Table 1. Valuation of Fisheries (in US$)

fishing	Economic value ($)
Commercial fishing	65,701
Ornamental fishes	35,260
Recreational fishing	60,000
Total	**160,962**

It can be seen from Table 1 that 41% and 37% of total fishing belong to commercial and recreational fishing and the 22% of the rest is the share of the ornamental fishes. The second part of the direct use value is measuring total recreational value. One major measure of total recreational value is a consumer surplus. Since traveling to Kish Island to see the coral reefs is not the main purposes of all visitors and so that the travel cost method will overestimate the consumer surplus. For this reason the CVM has been applied to determine the appropriate measure of the consumer surplus. The CVM is applying to capture the population's willingness to pay (WTP) for the conservation values like option, existence and bequest values of the coral reefs and to measure the willingness to accept (WTA) as a compensation if the environmental goods and services like wetlands, forests and marine resources were lost or unavailable (Wattage 2002). This method has been commonly used as one of the standard and flexible approach to measure the economic values (Hanemann, 1994), to determine the damages of the passive use values supported by Arrow *et al.*, (1993), to estimate the economic value of non-market goods with questionnaire-based approach (Hanemann *et al.*, Madani 1991; Venkatachalam, 2003). In this paper, a standard CV approach is designed lying between the single-bounded (Hanemann, 1984) and double-bounded dichotomous choice (Hanneman. Loomis, and Kanninen) formats. The questionnaire for interviews was carefully designed to provide respondents with adequate and accurate information, making them fully aware of the hypothetical market situation (Lee, 1984).

In Kish Island, the visitors will see the coral reefs habitat with two different ways, one is diving and the other is glass shipping. By applying the double bounded format for each of these activities, their values are obtained from SNPDF estimator. This result of total consumer surpluses is shown in Table 2 for each option.

It is clear from the above table that the number of visitors for glass shipping is almost two times more than the divining visitors in contrast with the share of consumer surplus of diving choice is 94% against 6% of the glass shipping visitors' consumer surpluses.

To calculate the producer surpluses as another part of total recreational value, using the production function approach, total expenditure related to marine activities are separated into direct and indirect costs. The actual direct expenditures connected to diving experience consists of entry fee, hiring of mask and fins, bus fare etc where 25% of these expenditures has been considered as value added. The indirect expenditures of the marine experience includes hotel and travel costs. It is assumed that 35% of the hotel cost creates the value added for the Kish economy. Due to this survey, marine activities such as diving and glass ship form 18% of the total motivation of visitors to come to Kish Island. Since most visitors come to Kish Island using travel tours, they don't spend any money for air ticket. Finally, we add the multiplier of the real expenditures for tourism announced by central bank at the rate of 3.5 allocated to the development of the Kish Island Economy. The recreational valve as the sum of consumer and producer surpluses is obtained which is shown in Table 3.

As can see from the above table, the share of glass shipping activity in total recreational value is about 56% and the remainder is accounted for the diving activity**.** The third component of the direct use value is about the research value which is determined in straightforward manner. In order to assign an amount for the research value, all research budgets that are allocated to coral reef ecosystems in Kish Island are collected from all relevant institute and organizations. In this case all potential research candidates were asked to provide their annual budget for the year of 2009 which is reported in the Table 4.

Table 4 shows that the share of research budget belongs to Iranian Fisheries Organization is about 37% and to Kish Free Trade Zone Organization is around 32%. Therefore, these two research institutes are potentially active in doing research in the area of Coral reefs economics. Up to now the major parts of direct use value are estimated, it is now more important to emphasize on the measurement of indirect use value as well as non use value of the coral reefs ecosystem.

Indirect use values have two main ecological services which coral reefs provide in Kish Island, calling shoreline protection and waste assimilation. Since these services are not tradable in the market so that the replacement and damage costs methods are the most suitable non-market methods used for calculating these values respectively. For shoreline protection it has been used of value at risk method so that the value of

Table 2. Total consumer surplus for year 2009 (in US$)

	Consumer surplus	Number of visitors	Total consumer surplus
Diving	63	9,000	568,080
Glass ship	2.5	15,000	40,125
Total	**65.5**	**24,000**	**608,205**

Table 3. Recreational value of Kish Island for year 2009 (in US$)

	Consumer surplus	Value added direct expenditure	Value added indirect	multiplier	Individual value added	Total recreational value
Diving	63	15	96	279	454	4,089,150
Glass boat	2.5	1	96	241	341	5,115,232
Total	**65.5**	**16**	**198**			**9,204,382**

Table 4. Kish Island coral reef-related research funds allocated in 2009 (in US$)

Research source	Amount
Iranian National Institute for Oceanography	85,000
Natural Resource Conservation Organization	35,000
Kish Free Trade Zone Organization	125,000
Iranian Fisheries Research Organization	146,000
Total value	**391,000**

shoreline which is close to sea is the main asset to find the value. The average net present value of shoreline land vulnerable threaten to erosion in the Kish Island is to be estimated around 300 US$ per square meter in 2009. Using approximately 5000 meters of shoreline within the Kish Island and also assuming that the first 30 meters of shoreline property under erosion risk, therefore the amount of 150,000 square meters will be being under vulnerable erosion risk. If this amount is multiplied to the shoreline price, it becomes 45 million dollar with consideration of erosion rate as 0.02 percent per year; the value of coastal protection is calculated as 900,000 dollar shown the protective function of the coral reefs.

Another potential indirect benefit resulted from the function of coral reef is the assimilation of wastes, pollution and discharge from anthropogenic sources. To quantify this benefit, the cost of filters which should have used instead of coral reefs is considered. Due to interview with specialist in Kish Island, there are 800 filters for the water machines that must be changed every 10 to 15 days, depending on the clearance of the sea water. The cost of each filter is about of 30 US$ as it has been changed. The changes have occurred 24 times in each year. After doing calculations, the values of both coral reefs functions are reported in Table5.The share of service attributed to the coastal protection is about 61% and the remainder assigned to waste assimilation service is 39%.

In terms of the non-use values, the conservation benefits of the Kish Island's coral reefs have been valued by means of the contingent valuation method, showing their economic importance of the existence and bequest values of the coral reefs ecosystem. As a stated willingness to pay, its mean for conservation value of coral reefs is predicted, using equation 2. Statistical analysis of variables and estimating parameters of SNPDF model carried out by SPSS and GAUSS software, respectively. A program for the application of the SNPDF model has written in the GAUSS language by Creel (1997). The result of a SNPDF estimator for contingent valuation method has shown in Table 6. From Table 6, it is seen that the coefficient of age variable (A) and education (E) are positive, income (I) is positive and it means that the probability of acceptance to pay the bid price increases as income goes up. The coefficient bid (B) is negative as expected and significant. As the u_a and v_a coefficients are entered, several of these coefficients are significant, suggesting the SNPDF model is capturing nonlinearities (Creel and Loomis, 1997). Table 6 indicates that the annual mean WTP for conservation value of Kish Island's coral reefs is about 53490 RLs (US$ 5.3) per household. From Table 6, it is seen that the coefficient of age variable (A) and education (E) are positive, income (I) is positive and it means that the probability of acceptance to pay the bid price increases as income goes up. The coefficient bid (B) is negative as expected and significant. As the u_a and v_a coefficients are entered, several of these coefficients are significant, suggesting the SNPDF model is capturing nonlinearities (Creel and Loomis, 1997). Table 6 indicates that the annual mean WTP for conservation value of Kish Island's coral reefs is about 53490 RLs (US$ 5.3) per household.

The area of Persian Gulf under sovereignty of the Iranian Government is proximately 920 hectare if the conservation value of 51498968 is divided into the Persian Gulf area; it becomes $ 55,975 as per hectare conservation value which shown in Table7. Since the Kish Island is about 62 hectare by multiplying it so that the total value of Kish Island becomes 3,463,052 United State dollar.US$.

Total economic value of the coral reefs of Kish Island is to sum up all its components which are presented in Table 8.

Table 8, indicates that in the total economic value, the shares of recreational and conservation values are

Table 5. Ecological Services or Coral Reefs in Kish Island in 2009 (in US$)

	Value of each hectare	Value of Kish Island
Waste assimilation	26,000	576,000
Coastal Protection	14,500	900,000
Total value	**40,500**	**1,476,000**

Table 6.Coefficient Estimates, Standard Errors of SNPDF Model

Coefficient	Est.	Standard Error	T-statistics
δ	-3.53	5.647	-0.6251
Age (A)	0.001616	0.02694	0.05998
Education (E)	0.3101	0.3444	0.9005
Income (I)	0.000187	0.0005629	0.3323
Bid (B)	-0.000226	0.0001073	-2.106
u_A	-0.01216	0.1727	-0.07038
v_A	-0.1256	0.3081	-0.4078
u_E	-0.5748	0.7217	-0.7964
v_E	0.321	0.2742	1.17
u_I	-0.0376	0.1467	-0.2562
v_I	-0.1958	0.1815	-1.079
u_B	-0.03796	0.1427	-0.266
v_B	0.3572	0.1353	2.641
Log –L : -598.264			
McFadden's R^2= 0.05223			
Mad alla's R^2= 0.06624			
Cragg&Uhler's R^2 = 0.02613			
Estimated WTP, all Variables at sample means = 53490 Rls = 5.3 US$			

Table 7. Conservation value of Kish Island coral reef (in US$)

Region	Total number of households in region	Share of households with non-use value	Number of households with non-use value	WTP	Total non-use value
Kish Island	6168	100%	6,168	5.3	32,992
All household in Iran except Kish Island	17,493,832	55%	9,621,607	5.3	51,465,975
Total					51,498,968

Table 8. Total Economic Value of Kish Island coral reefs in 2009 (in US$)

Uses of coral reefs	Value amount
Direct extractive uses	
Fisheries (food or aquarium)	**160,962**
Direct non-extractive uses	
Recreational value	**9,204,382**
Tourism (consumer surplus)	
Tourism (producer surplus)	
Education & research	**391,000**
Indirect uses	
Coastal protection	**1,476,000**
Waste assimilation	
Non-use values	
Existence	**3,463,052**
Bequest	
Option value	
Total Economic Value	**14,695,396**

about 62% and 23% respectively. The economic value of the coastal protection and waste assimilation function of coral reefs are 10% which is a significant element in the total economic value of the coral reefs. As mentioned above, the area of Kish Island coral reefs are 62 hectare, so by dividing the total value to this area we could calculate the value of one hectare of Kish Island coral reef which is about US$237,000 in 2009. It should be noted that this is the minimum value of this unique ecosystem and by adding more details, it will become higher.

CONCLUSION

This study has estimated the total economic value of the coral reefs ecosystem in the Kish Island of Persian Gulf in Iran. The key goods and services provided by the coral reefs in this area, including recreational activities, fisheries (direct use, extractive value), conservation values (non-use value), research and education benefits (direct use, non extractive value), and waste assimilation and coastal protection (indirect use value). Since total economic value of an ecosystem is equivalent to the sum of its parts, it is about 14 million United State dollar assigned to the coral reefs of the Kish Island for each year.

The largest component of total economic value is about 62% attributed to the recreational value. This is followed by conservation value which makes up about 23% of the TEV. Since coastal protection and waste assimilation function of coral reefs are 10%, it is also a suitable factor in illustrating total economic value. The value of one hectare of Kish Island coral reef is about US$237,000 in 2009 that is compatible with other studies. This study is the first one regarding total economic value of coral reefs ecosystem in Kish Island of Persian Gulf and adds a significant contribution to the literature. It is a good starting point for the further future valuation researches, allowing all aspects and detailed economic evaluation of Iran's marine resources.

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