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Economic Valuation of Use Values of Environmental Services in Lar National Park in Iran

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ABSTRACT

Today, national parks as a natural resource capital are facing many challenges. Therefore, economic valuation of its functions and services is one of the most important categories of planning and sustainable ecosystem management. The present study aimed to estimate the economic value of ecosystem services in the Lar National Park, Iran. To this aim, the methods of revealed willingness to pay, imputed willingness to pay, and expressed willingness to pay were used. The results of this research showed the economic value of water resources reservation services (1619.802 Million Dollars, $M), soil conservation services (9.218 $M), soil production services (0.804 $M), recreation services (3.004 $M), habitat service (36.722 $M), production services (1.312 $M), carbon sequestration (847.109 $M), and oxygen supply services (93.618 $M). Finally, the total economic valuation of the use services was estimated to be $1867.087 M. Since more than 97% of the values are related to the water conservation and gas regulation services, sustainable ecosystem management is essential for preserving and expanding these services.

Keywords: Ecosystem management, Ecosystem services, Willingness to pay.

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INTRODUCTION

In the last decade, the concept of ecosystem services has received increasing attention in scientific and policy contexts because of its capacity to bridge the connections between ecosystems and social systems (Carpenter *et al.*, 2009; Reyers *et al.*, 2013), as well as integrating ecological, socio-cultural, and economic approaches in knowledge building and policy development (de Groot *et al.*, 2010; Chan *et al.*, 2012). Environmental problems are regarded as a danger for human all over the world and their effects on ecosystem services challenge conservation, management, and rehabilitation activities (Ayele *et al.*, 2014; Haregeweyn *et al.*, 2015; Zewdu *et al.*, 2016). Ecosystems and the services they deliver underpin our very existence. Human depend on ecosystem services to produce their food and regulate our water supplies and climate. Also, it can protect human from extreme weather. Also, environmental functions and services have received less attention. For example, contact with nature can contribute to the spiritual experience and provide recreational enjoyment, which plays a positive impact on long-term health and happiness. Despite their importance, ecosystem services are consistently undervalued in conventional economic analyses and decisions. Ensuring that the true value of ecosystem services becomes fully incorporated into decision-making at all levels is regarded as the challenge (BCN and DNPWC, 2012). Globally, the creation of national parks and other protected areas has been an important strategy in biodiversity conservation, as well as helping to preserve natural ecosystems for the benefit and enjoyment of future generations. The idea of preserving natural landscapes first came to Iran in the early 1960s, initially as part of an effort to protect game animals and later as a more general attempt to save natural environments from further destruction (Seyed-

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Emami and Ashayeri, 2016). Protected Areas (PAs) and National Parks (NPs) have allocated the highest percentage of all spatial forms of global protected areas (ca. 24%) (Chape *et. al*., 2003) and are recognized as the most important core units for in situ conservation (Chape, *et. al*., 2005). In addition, NPs and PAs are important in enhancing conservation works, ensuring wildlife safety, and maintaining biodiversity and several ecosystem services (Whitelaw *et al*., 2014; Karanth and DeFries, 2011). The declaration of PAs has globally increased due to an increase in environmental sensitivity (Wandersee *et al*., 2012), countering the threats of climate change (Ruiz-Mallén *et al*., 2015), land-use changes (Martínez-Fernández *et al*., 2015), deforestation (FAO, 2010), the risk of flooding (Saraswati, 2014), the risk of forest fires (Chuvieco *et al*., 2014), habitat fragmentation (Dantas de Paula, 2015), the propagation of invasive species (Lei *et al*., 2014), recreational use (Mayer and Woltering, 2018; Paltriguera *et al*., 2018; Hermes *et al*., 2018; Sanna and Eja, 2017; López Lambas and Ricci, 2014) and conservation (Adams *et al*., 2008; Börger *et al*., 2014).

According to the book of the Law on Conservation and Improvement of Natural Areas, four areas including: (1) National Parks, (2) National Nature Monuments, (3) Wildlife Refuges, and (4) Protected Areas are managed by the Department Of the Environment (DOE) in Iran (DOE, 2019). Today, an aggregate of 281 ensured territories, including thirty national parks, cover a little more than 10 percent of the nation's territory mass and inland lakes. The possibility of nature preservation has pursued its own specific course in Iran and its ensured zones do not constantly meet the measures set by the International Union for Conservation of Nature (IUCN). Then again, nature preservation has a long history in Iran and the nation has a standout amongst the broadest systems of parks and secured territories in the Middle East and Asia (Seyed-Emami and Ashayeri, 2016).

Ecosystem accounting is useful to quantify and monitor the contributions of ecosystems to human well-being (European Commission and European Environment Agency, 2016). Understanding and measuring the associated contributions to human well-being is the domain of economic valuation, hence it is important at the onset of this report to link notions of ecosystem services with concepts of human well-being and economic value. Economists define the value of a particular good or service as what it is worth to people, in terms of the contribution of the good or service to well-being (Bockstael, *et al*,. 2007). Valuation of any sort requires an understanding of how changes in environmental goods and services affect human well-being, and then determining how much individuals are Willing To Pay (WTP) for beneficial changes, or Willing To Accept (WTA) as compensation for unfavorable changes (Barbier, *et al*., 2011). Without an understanding of the monetary worth of natural resources, conservation efforts may be stymied because they are viewed as costly in terms of precluding activities that have large immediate financial rewards (Schuhmann, *et al*., 2011). Despite significant advances in the development of the ecosystem services concept across the science and policy arenas, the valuation of ecosystem services to guide sustainable development remains challenging, especially at a local scale and in data-scarce regions (Pandeya, *et al*., 2016).

Given that national parks have many ecological services, which affect human life both directly and indirectly, the present study aimed to determine the economic value of Lar National Park direct use and indirect use services in 2017 by considering the benefits of the services quantitatively, and accordingly determining the economic value of these services by using monetary units. These services included the followings: direct use value of the park including recreation services, production services, and indirect use including water resources reservation services, soil conservation services, soil production services, habitat service, oxygen supply services and carbon sequestration Finally, we aimed to prepare the economic value map for ecosystem services within the boundaries of the study area.

MATERIALS AND METHODS

Study Area

Lar National Park, as a protected area at the foot of Mount Damavand, is located between the Provinces of Mazandaran and Tehran in Iran.

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The park, with an area of around 28,037 hectares, is home to several species of fauna such as brown bear, viper, partridge, agama, and red-spotted trout. The presence of red tropical salmon, which is one of the rarest species in the world, has doubled the importance of this collection. The park has very beautiful views. Fountains and rivers, the safe habitats of this beautiful valley make it more refined and charming. The park has been announced as a protected area since 1982 by the Department Of Environment (DOE). Further, grazing livestock, over pasture capacity, and irresponsible tourism is considered as the main threats related to this park. Furthermore, eliminating overgrazing prevents soil erosion, which can increase water resources, protect the biodiversity of the area, and provide forage. Regarding the association of the Lar National Park with the surrounding hydrological units, 72,855 hectares of the watershed or the area of the Lar Forbidden Hunting and National Park Area was considered in the present study instead of the area of 28,037 hectares of the park, due to consideration of ecological issues (DOE, 2002) (Figure 1).

Economic Valuation Methods

Economic valuation simply means estimating what something is worth to a group of people or to society at large. In short, valuation is the monetization of the benefits or costs associated with a good or service. We can understand the value of a good or service by observing what most people are willing to give up (i.e., trade) to attain it (Schuhmann, 2012). Payment for Ecosystem Services (PES) spread rapidly in the last decade and is defined as a new conservation paradigm (Jindal *et al*., 2013), as the popular mode for governmental and non-governmental agencies use in environment protection, as the domain practical approach of commercialization of ecosystem services (Muradian, 2010). Different ways of viewing human-nature interactions affect the ways in which these are conceptualized and operationalized with regards to Cultural Ecosystem Services (CES) (Sanna and Eja, 2017). Considering the different services of the Lar National Park, the ecosystem services of water resources storage, soil conservation, soil production, tourism, habitat, production, and regulation of gas were valued in the present study. To achieve our research objectives, we employed a mixed method design utilizing market prices (revealed willingness to pay), circumstantial evidence (imputed willingness to pay) and surveys (expressed willingness to pay) methods.

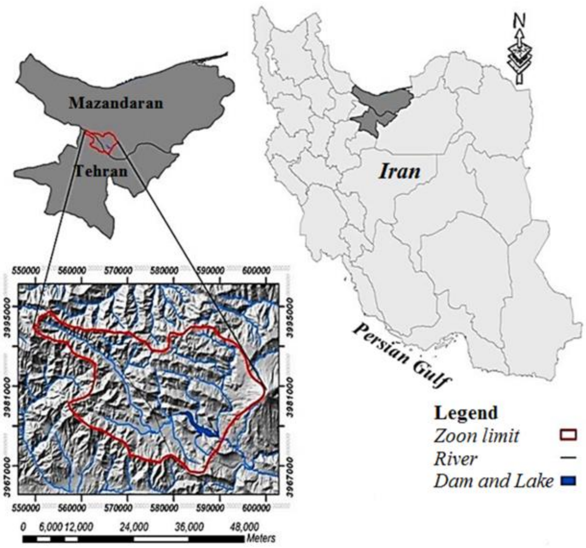

Figure 1. Location of Lar Forbidden Hunting and National Park Area in Mazandaran and Tehran Provinces.

Travel Cost Method (TCM)

The market price method uses common prices for goods and services in markets. Further, it indicates the unit value of that product or service by assuming that the goods have been sold through a fully competitive market (Amirnejad and Ataie Solout, 2011). TCM is considered as one of the market-based methods. The TCM primarily derives the value of recreation sites from the costs expressed in the market for trips to the recreational areas. Thus, it is mainly used to determine the values related to ecosystem services and biodiversity of public non-market environmental goods such as national parks, beaches, woodland, etc. (TEEB, 2010). A simple TCM model can be defined by a trip generation function (f) as follows (Equation 1):

$$V_i = f(C_i, X_i) \quad (1)$$

Where, V is considered as the number of Visits from a recreation site with people *i*, *C* indicates the Cost per visit, and X represents another social variable that significantly explains *V*. (Lansdell and Gangadharan, 2003). In addition, a linear regression model with method of Ordinary Least Square (OLS) was used to estimate the travel function. Least squares method is the method that minimizes the error due to the parameter modeling of the selection model. Using least squares method, the summation of the squared differences between actual and estimated output values are minimized by gradient descent (Wooldridge, 2012).

The demand curve for recreation is defined by $\frac{V_i}{C_i}$ and the consumer surplus for each person is obtained by calculating the following level of demand function in the interval between payment price and choke price. In other words, the consumer surplus is below the demand curve and above the payment price line and the surplus of consumers for the recreational area is obtained by multiplying the area below the curve $\frac{V_i}{C_i}$ by the number of annual visitors of the recreation area (Equation 2) (Amirnejad and Ataie Solout, 2011):

$$Consemer\ surplus = N_i \int f(C_i, X_i) dC_i \quad (2)$$

Where, N_i is considered as the Number of annual visits from the recreation site.

Replacement Cost Method (RCM)

Soil erosion causes a reduction in soil nutrients and thus soil productivity is adversely affected. RCM is regarded as one of the Circumstantial Evidence (Imputed Willingness to Pay) methods. RCM was used to estimate the cost of soil erosion, where economic valuation of losses from soil erosion was accomplished indirectly by looking at what cost society had to pay to retain the land productivity at levels prior to the erosion that used in several research such as Panagos *et al*. (2018), Martínez-Casasnovas and Ramos, (2006), Möller and Ranke (2006), Hein (2007), Graves *et al*. (2015), Dixon *et al*. (1994), Enters (1998), and Bojo (1996). Particularly, RCM seeks prices and quantities of goods traded in the market that can operate as the substitutes for the extra-market goods that are sought to value (López-Morales and Mesa-Jurado, 2017). In other words, RCM uses the cost of replacing an ecosystem or its services as an estimate for the value of an ecosystem or its services (Amirnejad and Ataie Solout, 2011). For example, the Nutrient Replacement Cost Method (NRCM) was used to determine the economic value of the soil conservation service in the present study. This method, known as the cost of nutrient evacuation, seeks to revitalize the eroded soil to pre-erosion levels. In this method, the cost of purchasing the fertilizer required to maintain and restore soil productivity (the acquisition of nutrients by soil) is calculated.

Contingent Valuation Method (CVM)

CVM is considered as one of the surveys or expressed willingness to pay methods. Contingent valuation is an economic tool used for estimating the value that a person places on environmental goods and services, which is particularly useful for estimating the values of non-market and non-use goods and services. In addition, it involves a number of possible uses for environmental decision-making, such as measuring willingness to pay for environmental changes, risk assessment in environmental litigation and policy formulation, and evaluating investments

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(Duberstein and de Steiguer, 2013). In economic theories, changes in consumer welfare are measured by estimating consumer surplus and Compensatory Variations (CVs), which express the Willingness To Pay (WTP) for goods (Bocksteal and McConnel, 2007). This measurement is performed in the framework of discrete estimation methods by using the data of the One and One-Half Bound (OOHB) choice questionnaires (Amirnejad and Ataie Solout, 2011).

Regarding the OOHB, the responsive person faces the price spectrum (B_i^D, B_i^U) from the beginning, so thatB_i^U can become bigger than B_i^D. Then, one of these two prices is selected at random and the respondent is asked whether s/he is willing to pay the amount or not. Further, s/he is asked about the second price only when it is compatible with her/his response to the first price. If the lower price B_i^- is randomly drawn as the starting bid, the three possible response outcomes are (No), (Yes, No) and (Yes, Yes), which are demonstrated by the corresponding response probabilities $\pi_i^N, \pi_i^{YN}, \pi_i^{YY}$, respectively. If the higher price B_i^+ is randomly drawn as the starting bid, the possible response outcomes are (Yes), (No, Yes) and (No, No), which are represented by the corresponding response probabilities π_i^Y, π_i^{NY}, π_i^{NN}, respectively. Assuming that:

$$\pi_i^N = \pi_i^{NN} = Pr\{C_i \le B_i^-\} = G(B_i^-;\theta) \quad (3)$$

$$\pi_i^{YN} = \pi_i^{NY} = Pr\{B_i^- \le C_i \le B_i^+\} = G(B_i^+;\theta) - G(B_i^-;\theta) \quad (4)$$

$$\pi_i^{YY} = \pi_i^Y = Pr\{C_i \ge B_i^+\} = 1 - G(B_i^+;\theta) \quad (5)$$

Let $d_i^N = 1$ if either the starting bid is B_i^- and the response is (No) or the starting bid is B_i^+ and the response is (No, No), and 0 otherwise. Let $d_i^{YN} = 1$ if either the starting bid is B_i^- and the response is (Yes, No), or the starting bid is B_i^+ and the response is (No, Yes), and 0 otherwise. In addition, let $d_i^{YY} = 1$ if either the starting bid is B_i^- and the response is (Yes, Yes) or the starting bid is B_i^+ and the response as (Yes), and 0 otherwise. Then, the log-likelihood function for the responses to a CV survey is as follows by using the OOHB format:

$$lnL^{OOHB}(\theta) = \sum_{i=1}^{N}\{d_i^Y \ln[1 - G(B_i^+;\ \theta)] + d_i^{YN} \ln[G(B_i^+;\ \theta) - G(B_i^-;\ \theta)] + d_i^N \ln[G(B_i^-;\ \theta)]\} \quad (6)$$

Resulting MLE from $\hat{\theta}^{OOHB}$ OOHB, the associated information matrix, $I^{OOHB}(\hat{\theta}^{OOHB})$ is equal to minus the expectation of the Hessian of the maximized log-likelihood function in Equation (6) (Cooper *et al.*, 2002).

The structure of the OOHB questionnaire in determining the individuals' willing to pay has a binary dependent variable. Therefore, the Logit model can be evaluated to determine the effect of different explanatory variables on the visitors' willingness to pay to determine the economic value. Finally, based on the Logit model, the probability that a person can accept one of the proposed amounts is a standard logistic distribution function with a standard logistic difference and may include some socioeconomic variables. Then, the expected value of willingness to pay is calculated by numerical integration in the range from zero to highest bid as follows (Amirnejad and Ataie solout, 2011; Amirnejad *et al*., 2006):

$$E\ (WTP) = \int_0^{Max\ BID} \left(\frac{1}{1+\exp\{-(\alpha^* + \beta \times BID)\}}\right) dBID \quad (7)$$

Where, E (WTP) is the Expected value of WTP and α^* is the adjusted intercept that was added by the socio-economic term to the original intercept term of α $(\alpha^* = \alpha + \gamma Y + \theta S)$.

Data

In the present study, various data in 2017 were collected since different services were valued. The water price data from the International Panel on Irrigation and Drainage (ICID) of Ministry of Energy were used for determining the economic value of water resources reservation services, surface water, and groundwater and evapotranspiration data. Further, the soil of the study area was classified into four erosion types from E_1 to E_4 to determine the economic value of soil conservation and production. The classification is based on the calculations of the Bureau of Land Management (BLM) table. Then, the

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PSIAC model was used to determine sediment and erosion. Also, NPK fertilizer market prices were used to evaluate the economic value of soil production and prevent soil erosion. To estimate the recreation value with the travel cost method, a questionnaire including travel cost information and the number of visits to the study area, along with other socioeconomic variables was implemented. Also, the question is the variable under investigation to determine sample volume according to its responding variance. The variance of the responses was calculated as 0.53 for 45 completed pre-questionnaires. Due to the annual number of 18,000 visitors to the park, the appropriate volume of the sample using Cochran's formula was estimated as 205 and, finally, according to 205correct questionnaires, investigation of preferences and associated analysis were done. Also, respondents included people who had visited at least once Bamou National Park (BNP) and enjoyed its benefits.

To determine the economic value of the habitat service, hunting fines approved by the Supreme Council of the Environment have been used. Further, the International Panel on Climate Change (IPCC) data was used to calculate the economic value of gas regulation services. In this study, the carbon and biodiversity database (https://www.unep-wcmc.org/carbon-biodiversity-discontinued) of the United Nations Environment Program (UNEP) was utilized to estimate carbon sequestration in LFHNPA. Furthermore, photosynthesis was used to evaluate the oxygen supply. According to the formula of photosynthesis, plants absorb 264 grams of carbon dioxide and combine it with 108 grams of water, and release 193 grams of oxygen (Xue and Tisdell, 2001). Finally, (1) To estimate the equations, the SHAZAM package, (2) For value mapping and Geographical analysis, ArcGIS package, and (3) For calculating mathematical equations such as integration, Maple software was used.

RESULTS

Economic Value of Water Resources Reservation Services

Out of 554.2 million m^3 of water entering the Lar Drainage Basin, 100.4 million m^3 (MCM) of annual rainfall between the basin and the entrance to the lake was used for recharging groundwater aquifers and 453.8 MCM entered the Lar Lake. Then, an RCM was used to estimate the economic value of water in the basin of the Lar Forbidden Hunting and National Park Area (LFHNPA). To do this, after determining the amount of water conserved in LFHNPA, this amount (in m^3) was multiplied by the price of the economic effect (the price per m^3 of conserved water in terms of monetary unit announced by ICID). According to ICID of the Ministry of Energy, the economic value of water per m^3 was 2.923 Dollars. Thus, the economic value of water conserved in the whole basin was estimated at 1619.805 \$M and 22.233 thousand Dollars per hectare (Figure 2-a).

If the ecosystem of the LFHNPA is at its maximum capacity to provide water conserved services, the value of the water related to this service is \$22.233 K ha^{-1}. However, the value of this service decreases per hectare if a reduction occurs in the potential for this service for some reason.

Economic Value of Soil Conservation Services

In the present study, NRCM was used to evaluate the economic value of the soil conservation service.As shown in Table 1, 320,196, 431,151, 85,593 and 32,184 tons, and the total of 869,124 tons of soil erosion were prevented in the various erosion types E1 to E4 in LFHNPA, respectively. It is worth noting that E1 represents mostly ungrazed areas in low slopes with very shallow to shallow pebbly soils; E2 represents areas of shallow to semi-deep soil, medium to heavy texture (loam to clay loam) with granular structure and high organic and pebbly organic matter; E3 represents the areas of shallow

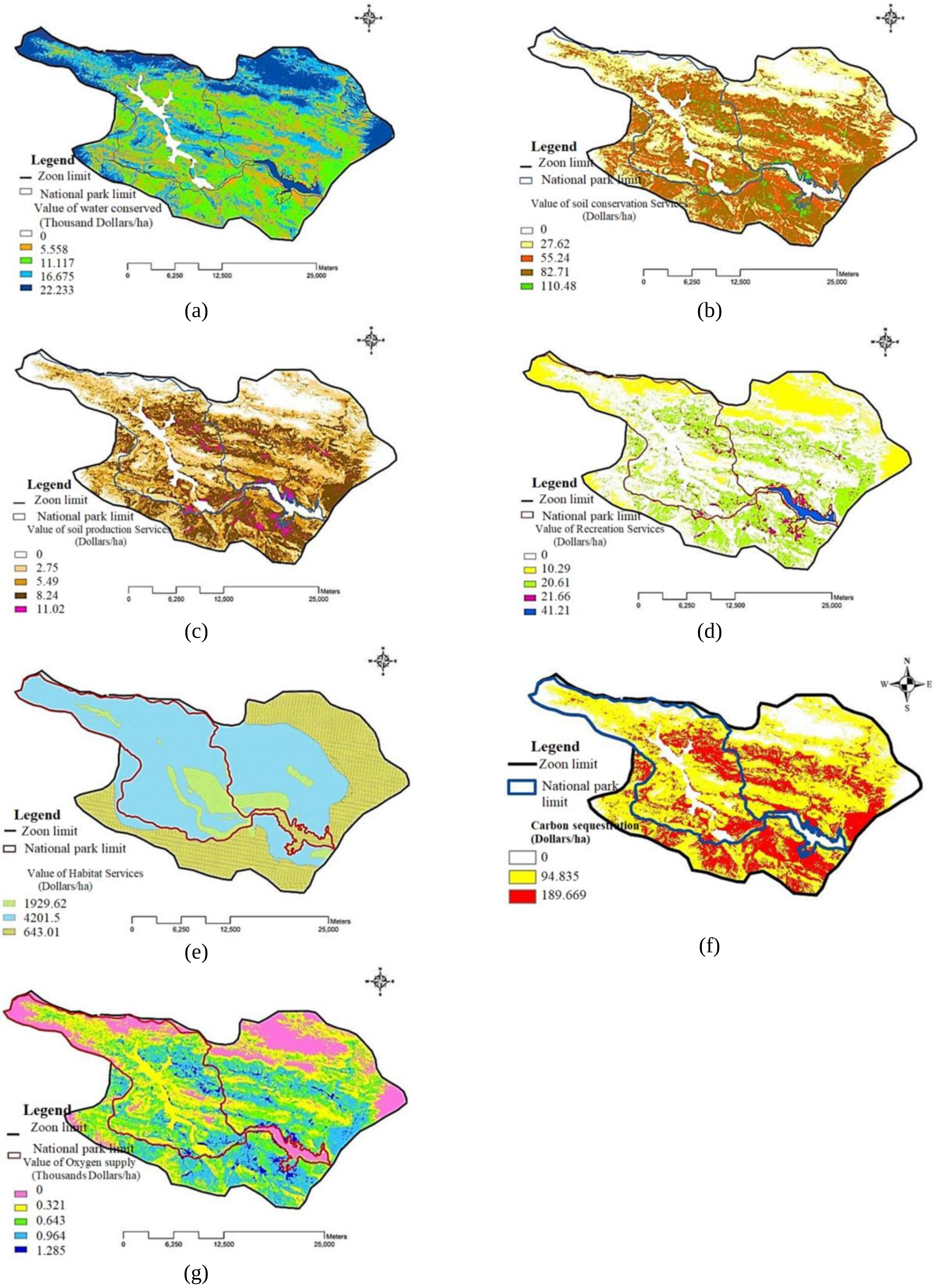

Figure 2. Map of economic value of, (a) water conserved services in LFHNPA, (b) the soil conservation service of the LFHNPA, (c) the soil production service of the LFHNPA, (d) the recreation services of the LFHNPA, (e) the habitat services of the LFHNPA, (f) the carbon sequestration of the LFHNPA, (g) the Oxygen supply of the LFHNPA.

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Table 1. Amount of conserved soil in LFHNPA.

Erosion types	Area (ha)	Amount of sediment control weight (Ton/ha)	Sediment delivery ratio (SDR)	Erosion amount of control (Ton)	Total amount of erosion in LFHNPA (Ton)	Total amount of erosion in the control level (Ton)	Erosion control ration in LFHNPA	Amount of soil conserved in LFHNPA (Ton)
E1	21831.557	5.5	0.33	16.67	43663	363859	0.12	320196
E2	35437.037	5.5	0.33	16.67	159467	590617	0.27	431151
E3	11035.194	5.5	0.39	14.1	70031	155625	0.45	85593
E4	4551.246	5.5	0.35	15.71	39336	71520	0.55	32184
Total	72855.034	-	-	-	312497	1181621	-	869124

soils, medium to heavy texture (loam to clay loam) with granular structure and relatively high and pebbly organic matter, and E4 represents areas of deep soil and medium to heavy texture (loam to clay loam) with granular, cubic and pebbly structure.

In the next step, the economic value of soil conservation was estimated. With respect to the market price of NPK fertilizer (20-20-20) and the amount of nutrient elements needed in the plant growth such as nitrogen, phosphorus, and potassium and those available in the soil of rangelands (0.12, 0.3 and 1.2%, respectively, by estimation). Therefore, the values of soil conservation in erosion types E1 to E4 were estimated to be 3.396, 4.573, 0.908, and 0.341 $M, respectively. In addition, the values of soil conservation per hectare of erosion types E1 to E4 were estimated to be $155.55, 129.04, 82.28, and 75, respectively. Finally, the values of soil conservation in the total area of this park were estimated to be 9.218 $M and $110.48 per hectare (**Error! Reference source not found.**2-b).

Economic Value of Soil Production

In order to estimate the amount of soil produced by the LFHNPA, we assumed that the time needed to form one centimeter of soil was 100 years and forest covered areas had a soil fertility factor of 100% rherefore, the amount of soil resulting from the crust process was estimated as follows:

Area of rangeland lands equivalent to forest land (ha):

$72855.034 \times 80\ \% = 58284.0272$

The volume of soil produced in 100 years (m^3):

$58284.0272 \times 10000 \times 0.01 = 5828402.72$

The volume of soil produced in one year (m^3):

$5828402.72 \div 100 = 58284.0272$

The weight of soil produced in one year (ton):

$58284.0272 \times 1.3 = 75769.2353$

The annual soil produced in the area of the LFHNPA was estimated to be 75,769 tons. Then, the Nutrient Replacement Cost Method (NRCM) was used to evaluate the economic value of the soil production service, which was estimated to be $803.663 K in the total area and 11.02 Dollars per hectare. (Figure 2-c) displays the economic value map of soil production service in the LFHNPA. Soil production factor was considered for low-density rangeland coverings to the highest density due to the difference in vegetation density (0, 25, 50, 75, and 100%) in different rangeland levels.

Recreation Value

Contingent Valuation Method (CVM)

In the present study, based on the information obtained from the initial questionnaires, the amount of willingness to pay each visitor for each family member to travel to the Lar National Park (NLP) included the main range of 0.292 to 0.877 Dollars (10,000 to 30,000 Rials). Accordingly, the OOHB selection questionnaire was designed for recreational performance valuation and

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was completed by 202 tourists. The final results of the Logit model estimation in the Table 2 indicated that desire to revisit (people who want to visit again were defined as 1 and others 0), ethically-consequence oriented (ethically defined 1 and consequence-oriented as 0), bid (in Rial), gender (man defined 1 and woman 0), number of education years and income (Million Rials) variables play a significant effect on the willingness to pay.

The variable of the suggestion or BID is significant at 10% probability level, and its effect on the probability of WTP is negative based on demand theory. Elasticity at mean implies that a 1 % increase in the BID variable causes a reduction as 0.15% of the probability acceptance of the proposed fee. Also, the estimated marginal effect indicates that a one-unit increase in proposed fees will decrease the acceptance likelihood by as much as 3.15×10-6 unit. In addition, the variable of desire to revisit is positive and significant at the 5% level. Indeed, people who want to visit again have more WTP for recreation in the LNP. The result of estimated marginal effects indicated that the acceptance likelihood of proposed fees is more by 0.194 unit among people who want to visit again. It should be noted that in binary variable, the Elasticity at mean would not be interpreted. Results of heteroscedasticity test with Wald Chi-Square test show that there is no problem about heteroscedasticity. The Likelihood Ratio Test with 1% significance indicates that the model is suitable and the significance level is appropriate. Percentage of right predictions shows that the estimated model was able to predict an acceptable percentage of the dependent variable concerning the explanatory variables.

Finally, using integral equation, the average recreational value (leisure, tourism and aesthetic) for each ethical and consequence-oriented household was estimated based on calculating the integral from the estimated equation in the range from the lowest to the highest bid:

$$WTP = \int_0^{30000} \frac{1}{1+exp\{-(-0.0000126\times BID)-0.0157)\}} = 13472 \ Rials\ for\ Consequence - \text{oriented household} \quad (8)$$

$$WTP = \int_0^{30000} \frac{1}{1+\exp\{-(-0.0000126\times BID)+0.3725)\}} = 16366 \ Rials\ for\ Ethical - \text{oriented household} \quad (9)$$

Further, by calculating the weighted average of the consequence and ethical households (0.46 and 0.54), the expected willingness to pay for each tourist per family member and each visit was estimated to be 15,035 Rials, equivalent to 0.439 Dollar per visit. Finally, the recreational value of the NLP with the CVM was estimated at $26.392 K per year, according to the number of visits (18,000) andaverage annual visit of each household (3.34) family members, and tourists with the CVM.

Travel Cost Method (TCM)

In the present study, the travel cost method was used to determine the recreational value of the park. Table 3 shows the results of estimating the travel cost function using the Ordinary Least Squares (OLS) method. Results of the heteroscedasticity test (the Wald Chi-Square test) shows that the model has the heteroscedasticity problem, So the heteroscedasticity problem was solved with the special commend in the SHAZAM software. Also, collinearity test in the SHAZAM software showed that there was no collinearity problem in the independent variables of the model.The desire to revisit, visiting other national parks, ethically-consequence oriented, the number of household members, and travel costs could play a significant effect on the number of visits. Finally, by using the estimated model in Table 3, the travel cost function of visitors to the NLP can be derived in the form of Equation (10), where TC and N indicate traveling costs, and the number of visits from NLP, respectively.

$$N = 8.66 - 6.5E\text{-}07\times TC \quad (10)$$

Table 2. Results of estimating the factors affecting the WTP for recreation by using the Logit model.

Variable	Coefficients	T-test	Elasticity at mean	Marginal effect
Bid	-1.26E-05	-1.84**	-0.154	-3.15E-06
Desire to revisit [a]	0.777	2.27**	0.311	0.194
Ethically-oriented consequence [a]	0.712	2.81**	0.188	0.178
Gender [a]	0.81	2.41**	0.326	0.202
Education	8.9E-02	2.73**	0.631	0.0223
Monthly income	9.8E-09	1.79**	0.107	-2.45E-09
Constant	-2.284	-4.26	-1.38	-
Likelihood Ratio Test = 31.12 with 6 D.F. P-Value= 0.00			Percentage of right Predictions =0.64	

[a] Binary variable. ** and *: Represent the significant levels of 5 and 10%, respectively.

Table 3. The estimation of factors affecting the number of tourists visiting LNP.

Variable	Coefficients	T-test	Elasticity at mean
Be on vacation [a]	-0.65	-0.62	-0.133
Residence in Tehran [a]	0.492	0.62	0.082
Join NGOs [a]	0.755	0.64	0.031
Distance	-2.26E-03	0.12	-5.60E-03
Duration of stay in the park	0.0626	0.81	0.085
Desire to revisit [a]	2.424	5.6***	0.4617
Visit other national parks [a]	1.688	2.33**	0.1483
Ethical-oriented consequence [a]	1.024	1.68*	0.1285
Age	-0.03	-1.25	-0.2595
Gender+	-0.777	-0.53	-0.1507
Education	-0.087	-1.11	-0.2933
Number of family members	0.352	2.71***	0.3163
Monthly income	-1.64E-08	-1.36	-0.0838
Travel costs	-6.5E-07	-2.89***	-0.2938
Constant	4.2018	2.72***	0.9678
R-square= 0.15 Log of the likelihood function= -602.57			

[a] Binary variable, ***, ** and *: Represent the significance levels of 1, 5 and 10%, respectively

In addition, the recreational value of each household was estimated to be $648.86 by using the integral calculation of the Equation (7) in the range of zero travel cost to the maximum travel cost for tourists. Further, the recreational value of LFHNPA by using the TCM was estimated to 3.004 $M with respect to the total number of visits from the LFHNPA and the average size of the household. Furthermore, the recreational value of each hectare of LFHNPA was estimated at $41.21. Given that TCM and CVM are based on market prices and hypothetical market, respectively, TCM was selected as the appropriate method for determining the recreational value.

(Figure2-d) illustrates the economic value map of the recreation services of LFHNPA. When rangeland levels have richer vegetation, they will have more economic value from the viewpoint of recreation due to the semi-desert conditions dominant in the study area. Rocky and mountainous areas, and upstream, are worthy aesthetically, but they have lower values in term of recreation in the form of willingness to pay for visitors. Other rocky and low-level rangeland levels were not attractive due to the lack of natural attractions of tourists, and lack of recreational value.

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Table 4. The estimated of the economic value of unique animal species of LFHNPA.

Species	Population estimate	Hunting fines for each unit (Dollars)	Economic value (Thousands Dollars)
Capra aegagrus	1400	2922.8	4091.89
Ovis orientalis gmelini	400	2922.8	1169.11
Panthera pardus	8	23382.2	187.06
Ursus arctus	10	14613.9	146.14
Aquila	21	5845.6	122.76
Tetraogallus caspicus	400	58.5	23.38
Vipera ursinii and latifii	7000	292.3	2045.95
Salmo Trutta fario	330000	87.7	28935.52
Total economic value of unique animal species			36721.81

Economic Value of the Habitat Service

Considering the specific characteristics of LFHNPA, this park can be used as an appropriate habitat for the conservation of these species. In this study, environmental fines of No. 380 of the Supreme Council for Environmental Protection were considered as an alternative to animal species value. Table 4 indicates the economic value of unique animal species of LFHNPA. Accordingly, the total economic value of the unique animal species of LFHNPA was estimated at 36.722 $M in the total area. (Figure2-e) illustrates the economic value map of habitat services of LFHNPA. In order to prepare this value map, the distribution map of animal habitats, especially unique species, were used to determine the areas having conservation value. For this purpose, the distribution areas of these species were prepared in two habitat classes of sensitive (high density) and non-sensitive (low density) and then they were overlapped. The areas including sensitive habitats for all unique species (Blue) were considered as the highest conservation value, while the low density (Green) areas had a moderate conservation value.

Economic Value of Production Service

The production services of LFHNPA are summarized in the forage and livestock production. Regarding forage production by the park pastures, it is worth noting that the value of forage harvested and consumed by tribes in the area was included in the value of the sold livestock. Thus, it is only necessary to determine the value of the produced livestock in order to avoid double valuation. In addition, the sheep breeding period (8 months), duration of sheep grazing in LFHNPA (100 days), average weight of sheep (20 kg) and sheep wholesale price were considered to calculate the value of livestock production in LFHNPA. Regarding 62134 livestock in the Lar National Park during the 100-day period from June to September (Ministry of Agriculture Jihad statistics, 2016), the value of livestock products in LFHNPA was equal to 1.312 $M.

Economic Value of Gas Regulation

The transfer of benefits and replacement cost methods was used to estimate the economic value of the gas regulation service such as carbon sequestration and supply of oxygen. In the process of photosynthesis, the plant produces biomass by absorbing carbon dioxide and releasing oxygen. As the carbohydrates accumulate in the plant, biomass is added to the plant and the process of carbon stabilization and oxygen supply continues.

Economic Value of Carbon Sequestration

Based on the results of the website in the Carbon and Biodiversity Calculator, the

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Table 5. Total economic value of the use services in LFHNPA.

			Total area (Million Dollars)	Ratio of total economic value (%)	Per ha (Dollar)
Economic value of the use services	Direct use	Production	1.312	0.07	18
		Recreation	3.004	0.16	41.21
		Total direct use	4.316	0.23	59.21
	Indirect use	Carbon Sequestration	102.604	5.50	14132
		Oxygen supply	93.618	5.01	1285
		Water conservation	1619.805	86.76	22233
		Soil conservation	9.218	0.49	110.48
		Soil production	0.804	0.04	11.02
		Habitats	36.722	1.97	504.04
		Total indirect use	1862.771	99.77	38276
		Total	1867.087	100	38335

amount of carbon sequestrated in LFHNPA was estimated to be 51.681 ton ha^{-1}. Since each ton of carbon per hectare is equivalent to 3.67 tons of carbon dioxide, the amount of carbon dioxide absorbed becomes 189.669 ton ha^{-1} and 5310739.56 tons in the LFHNPA. Further, the costs of the industrial process of carbon capture, as well as the air and its storage to the depths of the earth were estimated to measure the economic value of the process of carbon sequestration from the air by plant species. This method has been used in many developed countries like the United States (IPCC, 2005). Therefore, the data from the Intergovernmental Panel on Climate Change (IPCC) was used to calculate the economic value of the carbon sequestration service. According to the IPCC reports, the cost per ton of carbon dioxide fixing was $74.51 in 2014. The value of carbon sequestration was $14.132 K per hectare with regard to the carbon sequestration of 189.669 tons in soil and plants. Furthermore, the value of this service in the LFHNPA was estimated to be 1029.604 $M. (Figure2-f) illustrates the economic value map of the carbon sequestration service.

Economic Value of Oxygen Supply

Typically, 5-10% of carbon dioxide is absorbed in vegetation, and the rest is absorbed in the soil. Regarding 7.5% in this study, the total amount of carbon dioxide sequestrated in LFHNPA was 398,305.467 tons in vegetation. Therefore, 291,185.436 tons of oxygen were supplied throughout LFHNPA by using the photosynthetic formula. In addition, this amount of oxygen supply is equal to 3.997 tons of oxygen per hectare from LFHNPA. Then, the replacement cost method was used to determine the economic value of the supply of oxygen. Oxygen gas is produced by the air compression method in special capsules. As a result, oxygen gas is turned into liquid form and is removed from the compressor. According to data collected from the market level, the price per ton of industrial oxygen produced is $321.51. Therefore, the economic value of the supply of oxygen per hectare was estimated to be $1.285K while it was 93.618 $M for the LFHNPA (Figure 2g).

Finally, the economic value of use services in LFHNPA was estimated at 1,867.087 $M. Further, the value of each hectare of the park was estimated at $38,335. The results indicated that the direct use services (production and recreation) allocate a very small share (0.23%) of the total value. The most important part (99.77%) of use values was obtained indirectly, which reflects the necessity of intangible economic valuations of ecosystems such as services, soil erosion, carbon Sequestration, oxygen supply, and so on. Measuring all of these values contributes to deciding on various scenarios for using national parks. It is worth noting that water conservation and carbon dioxide stabilization are the most valuable services in the LFHNPA.

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CONCLUSIONS

Therefore, considering the effect of vegetation on preserving runoff, reducing soil erosion, and promoting the operation of gas regulation service, it is suggested that the Environmental Protection Agency will withdraw the tribesmen's livestock from the LFHNPA. If an unauthorized harvest of forage and medicinal plants leads to a10% reduction in the components of the relevant services, it results in decreasing the value of the carbon-dioxide stabilization service and the oxygen supply to 19.622 $M, the value of the water protection serviceto 161.98 $M,the value of the soil conservation service to 0.922 $M, and the value of the soil production service to 0.08 $M and, finally, the value of the non-direct use of the LFHNPA will decrease to 1684.482 $M. The limitations that researchers faced in this study were: (1) Low level of awareness of visitors and locals about national parks and the lack of distinction between forest parks and national parks; (2) Despite the ban on domestic livestock entering the national park, nearly 70,000 livestock are brought to the park for grazing in a few months of the year; and (3) The valuation of some services such as pollination and biological control was not possible due to lack of accurate information. Therefore, it is recommended that more functions be targeted in future studies, because by doing so, the estimates of the real value of the national park will be more accurately estimated.

In order to enhance the long-term sustainability of the LFHNPA services, the following suggestions are given:

Due to the very high economic value of some functions such as water regulation, carbon sequestration and oxygen supply in the study area, it is suggested to implement appropriate soil protection programs and controlling resource erosion in different types of soil erosion in the LFHNPA such as reviving vegetation, selecting sustainable species, and preventing livestock access to these lands, and controlling surface water on the slopes by constructing a suitable terrace to prevent the aggravation of surface erosion and groove erosion.

Considering that conservation of the environmental species of Lar National Park requires human resources, it is suggested to assess deficits in human resources and estimate the quantity and capacity of human resources for desirable management through training, using the capacity of public organizations or non-government organizations, supporting the protectors of nature, and improving physical care.

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ارزش‌گذاری اقتصادی ارزش‌های استفاده ای خدمات محیط زیستی در پارک ملی لار در ایران

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چکیده

امروزه، پارک‌های ملی به عنوان یک سرمایه‌ی منابع طبیعی با چالش‌های زیادی روبرو هستند. بنابراین، ارزش‌گذاری اقتصادی آن‌ها یکی از مهمترین مقولات در برنامه‌ریزی و مدیریت پایدار اکوسیستم است.پژوهش حاضر با هدف برآورد ارزش اقتصادی خدمات استفاده‌ای در پارک ملی لاردر ایران انجام شد. برای این منظور از روش‌های تمایل به پرداخت آشکارشده، تمایل به پرداخت نسبت داده شده و تمایل به پرداخت بیان‌شده، استفاده شده است. نتایج تحقیق حاضر، ارزش اقتصادی خدمات ذخیره‌سازی منابع آب (۱۶۱۹/۸۰۲ میلیون دلار)، خدمات حفاظت خاک (۹/۲۱۸ میلیون دلار)، خدمات تولید خاک (۰/۸۰۴ میلیون دلار)، خدمات تفرجی (۳/۰۰۴ میلیون دلار)، خدمات زیستگاهی (۳۶/۷۲۲ میلیون دلار)، خدمات تولیدی (۱/۳۱۲ میلیون دلار)، خدمات تثبیت کربن (۸۴۷/۱۰۹ میلیون دلار) و خدمات عرضه اکسیژن (۹۳/۶۱۸ میلیون دلار) را نشان داد. در نهایت ارزش اقتصادی کل خدمات استفاده ای پارک، برابر با ۱۸۶۷/۰۸۷ میلیون دلار برآورد شد. از آنجایی که بیش از ۹۷ درصد از ارزش‌ها، مربوط به خدمات ذخیره‌ی منابع آب و خدمات تنظیم گاز است، مدیریت پایدار اکوسیستم، برای حفظ و گسترش این خدمات ضروری است.

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