One Ecosystem 10: e108556
doi: 10.3897/oneeco.10.e108556

OPEN ACCESS

Research Article

# A comparison of valuation methods for cultural ecosystem services in support of ecosystem accounting

Anna Bronzes‡, Lars Hein§, Rolf Groeneveld|, Alim Pulatov¶

‡ Environmental Sciences, Open Universiteit, Heerlen, Netherlands
§ Earth Systems and Global Change, Wageningen University, Wageningen, Netherlands
| Environmental Economics and Natural Resources, Wageningen University, Wageningen, Netherlands
¶ EcoGIS Center, Tashkent Institute of Irrigation and Agricultural Mechanization Engineers, Tashkent, Uzbekistan

Corresponding author: Anna Bronzes (anna.bronzes@ou.nl)

Academic editor: Alessandra La Notte

Received: 23 Jun 2023 | Accepted: 16 Oct 2024 | Published: 17 Jan 2025

Citation: Bronzes A, Hein L, Groeneveld R, Pulatov A (2025) A comparison of valuation methods for cultural ecosystem services in support of ecosystem accounting. One Ecosystem 10: e108556. https://doi.org/10.3897/oneeco.10.e108556

## Abstract

Assigning an economic value to cultural ecosystem services is important to promote their sustainable and rational use. Valuation of such services requires a non-market approach as they are not traded on markets and, thus, have no directly observable market price. The System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA) aims to develop a systematic approach to value ecosystem services aligned with the valuation approach of the national accounts. However, valuing cultural services in SEEA-EA is challenging and different approaches have been developed. In this study, we compare four prominent approaches for valuing cultural ecosystem services: resource rent, travel cost method, simulated exchange value and consumer expenditure. We test and compare these methods in a case study of Ugam Chatkal State Nature National Park in Uzbekistan and examine to what degree the methods are aligned with accounting valuation principles. We note that the methods assess value in a different way and, accordingly, we find considerable differences amongst approaches in recreational value: values ranged between US$1.62M and US$65.19M annually. The lowest value was provided by the resource rent approach and the highest value by the travel cost method

including consumer surplus. This latter method is not aligned with SEEA-EA accounting; however, even the three methods that are aligned with accounting principles provide quite different value estimates. The two other approaches, simulated exchange value and consumer expenditure, provided an annual value of US$24.46M and US$13.5M, respectively. We find that a resource rent method is likely to underestimate the 'true' value of the service when used for accounting and that the simulated exchange value method seems to be best aligned with the valuation needs for cultural services for SEEA-EA.

## Keywords

ecosystem accounting, cultural ecosystem service, valuation method, recreational value, national park

## Introduction

Recognising and capturing the value of ecosystem services (ESs) is important to transition to more sustainable ecosystem management (Dendoncker et al. 2013). ESs are contributions to human well-being by natural ecosystems (TEEB 2010, UN et al. 2014, Haines-Young and Potschin-Young 2018, IPBES 2019). These contributions include, amongst other things, contributions to food provisioning, water and air purification, soil conservation and recreation (Burkhard and Maes 2017). Global growth of consumption is putting increasing pressure on ecosystems and their services (EEA 2019). According to the IPBES (2019), natural ecosystems condition worldwide have declined by 47% on average of their earliest estimated states and continuing to decline by at least 4% per decade. Therefore, to prevent the continued loss and degradation of ecosystems and their vital services, it is important to assign economic value to ESs (Richardson et al. 2015, Sannigrahi et al. 2019, Ali et al. 2020). An accurately assigned economic value to ESs will facilitate a better understanding of their contribution to human well-being and support more informed decision-making regarding resource management and conservation efforts (Bockstael et al. 2000, Sagger et al. 2021). This can help governments in setting policy directions for ecosystem management and conservation (Masiero et al. 2019). In this regard, the ecosystem accounting approach can play a vital role (Vallecillo et al. 2019) for the monitoring of the progress towards reaching sustainable ecosystem management regimes and provide a basis for decision-making on ecosystem management (Farrell et al. 2022).

The System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA) is a systematic approach to assess ecosystems and their uses in both physical and monetary terms, in a manner aligned with the System of National Accounts (UN et al. 2014, Badura et al. 2017, UN 2020, UN 2021). National accounts record the measures of economic activity, such as gross domestic product (GDP) and national income (UN 1953, UN et al. 2014). The contribution of ecosystems to standard measures of economic activity is important in the context of a more complete assessment of economic activity, as well as assessment of associated stocks and changes of the assets (UN et al. 2014, Hein

et al. 2020). To fulfil the aim, SEEA-EA conforms the accounting concepts and approaches, including the valuation principles, with national accounts. Since the basis for national accounts is the concept of exchange value, the SEEA-EA seeks to apply the exchange value for valuing the ESs (Obst et al. 2015). For most ESs, like provisioning services contributing to the production of food, fibre, fuel and regulating services for carbon sequestration, the valuation techniques for the estimation of exchange values are already established (UNSD 2017, Campos et al. 2019).

For the valuation of cultural ecosystem services, challenges remain (Cheng et al. 2019). The SEEA-EA defines cultural services as benefits raised from direct or indirect interaction of people with ecosystems during recreation, knowledge development, relaxation and spiritual reflection (UN et al. 2014). Most of the cultural services have characteristics of public goods. Public goods are associated with conditions of non-excludability and non-rivalry, which makes them susceptible to free-riding, i.e. people using them without paying for that use. This results in CESs not being traded on markets and thus have no directly observable market price. Consequently, there is no universal benchmark for assigning value to these services and a consistent method for valuing cultural assets is lacking (Lawton et al. 2021, Kaszynska et al. 2022). Hence, valuing such services demands an approach, independent of conventional markets (Ridding et al. 2018).

There have been several attempts to value CESs and propose valuation techniques that conform with the principles underlying the SEEA-EA (Remme et al. 2015, Caparrós et al. 2017, Pelletier et al. 2021). Currently, the four prominent approaches used to value CESs are resource rent, travel cost, simulated exchange value and consumer expenditure (Barton et al. 2019). The first approach, the resource rent (RR), complies with the SEEA-EA principles, as it captures the real exchange value of goods and services during the production or extraction. Remme et al. (2015) have estimated the value of nature tourism in the Dutch province of Limburg, using the RR valuation method. The inherence of the approach is that it excludes the consumer surplus from valuation, thereby the calculated values are shown considerably lower. The second approach, the travel cost method (TCM), estimates the recreational value of the site by considering the full travel costs, like cost of time, fuel and any applicable fees, that consumers are willing to spend in relation to visits the site (Trice and Wood 1958, Smith and Kopp 1980, Ward and Beal 2000, Graves 2013). We note that there are two different travel cost methods that measure different aspects of value and that are, somewhat confusingly, both called TCM (Garrod and Willis 1999). The first method states that the TCM uses actual travel expenses as an indicator of the value of the service. This has been used mainly in natural capital accounting, as in the natural capital accounts for the Netherlands (Horlings et al. 2019). In this paper, we will refer to this approach as the Consumer Expenditure approach, to avoid confusion. The second method, used widely in environmental economics, states that, based on travel costs and annual visitation rates, a demand curve for visiting a specific site is constructed. This leads to an estimate of the consumer surplus generated through recreational visits to a site (National Research Council 2005). However, according to the SEEA-EA, only the first TCM is considered as possibly appropriate,

based on the condition that consumer surplus and cost of time are excluded from measurements (UNSD 2017). The third approach, simulated exchange value (SEV), simulates the market transactions for goods and services for which prices do not exist. Caparrós et al. (2017) used the simulated exchange values (SEV) approach to assess the free access recreation in forests of Andalusia in Spain. The SEV is considered to have a high potential to be used within the SEEA-EA concept (Badura et al. 2017, Grilli et al. 2021, UN 2021, NCAVES and MAIA 2022). The fourth approach, the consumer expenditure (CE), is relevant to the travel cost method in its first interpretation and calculates the expenditure related to outdoor activities, for example, travel costs, accommodation costs (only for tourism), costs for food and drinks and other costs, which include admission fees. Horlings et al. (2019) have tested three scenarios (involving expenditure for different aspects) applying CE and calculated the associated nature-related expenditure of recreation and tourism in the Netherlands. The result provided considerable differences ranging from 3.2 billion to 9.8 billion euros.

With this background in mind, the objectives of this paper are to compare different valuation methods for CES and to examine which elements of value are not included if an accounting approach to valuation is used. Additionally, this research explores how the TCM (second variety described above) can be used to establish a demand curve in a SEV approach. In addressing these questions, the Ugam Chatkal State Nature National Park (UCNP) in Uzbekistan is selected as a study area. The research focuses on CESs in a part of recreational value provided in the study area.

The main novelty of this study is a comparison of four methods for valuing CESs on the example of one national park. This provides a more complete picture of the outcomes, showing the differences and similarities of value elements included or excluded in the accounting approach. The value of recreational services in the Ugam Chatkal State Nature National Park in Uzbekistan is presented for the first time. Moreover, as a pioneer, this study examines the use of demand curve from TCM to simulate the exchange value. This is done following Caparrós et al. (2017), who suggested that TCM could be used to simulate exchange values, as it estimates a Marshallian demand function.

The set-up of the paper is as follows: **Methodology** section provides a brief overview of the study area and introduces the methods used for the recreational value assessment. **Data collection and analysis** are following each method's description. **Results** section comes with the results, which are discussed in **Discussion** section. **Conclusion** section finalises with some concluding remarks.

## Methodology

### Case study area

The Ugam Chatkal State Nature National Park (UCNP) was established in 1990 on the basis of the Chatkal Reserve. The territory of the Park is 574.6 k ha (CMRU Resolution #262 2001, UNDP 2015), of which 69.06 k ha is forest, 176.3 k ha is pastures and

hayfields, 327.6 k ha is rocks and rocky slopes and 1.61 k ha is irrigated land (Tsoy and Ashirov 2008). The Park is located in Bostanlik (79.38%*[1]), Parkent (7.32%) and Akhangaran (13.3%) Districts of the Tashkent Province in Uzbekistan (41°55'33.9"N 70°31'37.0"E). The territory of the Park, within Uzbekistan's border, covers almost all mountain ranges of the Western Tien Shan, including Ugam, Maydantal, Pskem, Koksuy and Chatkal ranges (Todjibaev et al. 2008). The height of the territory ranges from 900 to 4216 m above sea level (Bensitova et al. 2014).

The Park borders the Sayram-Ugam State National Park and the Aksu-Zhabagly Nature Reserve in Kazakhstan and the Besh-Aral State Reserve in Kyrgyzstan. During the 40th session of the UNESCO World Heritage Committee, held on 17 July 2016, in Istanbul, it was decided that part of the Central Asian mountain system of the Tien Shan, covering the territories of Uzbekistan, Kazakhstan and Kyrgyzstan, was included in the UNESCO World Heritage List (UNESCO 2016). From the territory of Uzbekistan, the part of the Ugam-Chatkal State Nature National Park with the environmental zones of Maydantal and Bashkizylsay was added to the UNESCO World Heritage List.

The main purpose of the UCNP Park is to preserve the natural features of the Western Tien Shan, which have a special ecological, historical and aesthetic value and are intended to be used for environmental, recreational, educational, scientific and cultural purposes (see Fig. 1). Different protection regimes are established on the territory of the Park, depending on the condition and conservation of the natural complexes, the nature of the landscape and other factors. Based on these protection regimes, the Park is divided into several zones (CMRU Resolution #262 2001, CMRU Resolution #657 2018):

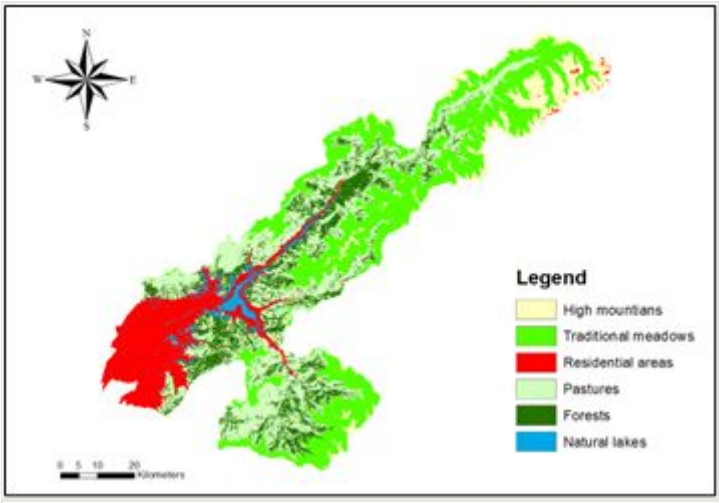


Figure 1.

Landscape of the Ugam Chatkal State National Nature Park (Bekchanova 2018).

a) protected zone, which includes the territory of the Chatkal State Biosphere Reserve;

b) border and borderline zone, as the territory of the Park borders with Kazakhstan and Kyrgyzstan counties;

c) natural and restored landscapes zones, with regulated recreational and economic activities;

d) active recreation zone, with camping houses, children's camps, tourist centres, sanatoriums.

The UCNP holds significant recreational value for residents of Tashkent and Tashkent Province, serving as the nearest natural area within an 80 km radius for citizens. The next best site, Zaamin National Park, is located 263 km away, requiring a 5-hour drive for those residing in the capital. Consequently, Zaamin National Park is not deemed a viable alternative for short-duration visits.

Further, it is important to mention that UCNP has a free entrance. The most popular places in the Park are: Chimgan ski resort, with the highest point Greater Chimgan - 3,309 m; Amirsoy and Beldersay ski resort with the longest alpine skiing track in Uzbekistan and a cableway with more than 3 km in length; Charvak reservoir with a wide range of hotels, houses, camping places and different types of accommodation; Bochki area with a range of cafes and restaurants at the entrance to Charvak Reservoir; Urungach natural lake, which is declared as a hydrological monument of nature etc.

According to the Cabinet of Ministries of the Republic of Uzbekistan decree №1053 from 31.12.19 “On rapid development of tourism in Tashkent province in 2019 – 2021” (CMRU Resolution #1053 2019), the Bostanlik and Parkent Districts were included in the tourism concept and called the Golden ring. The concept promotes the development of the regions, including the Charvak Reservoir area at the UCNP. The goal of the concept is to improve and increase tourism and recreational activities in the Tashkent Province. One of the concept plans is to extend the number of modern hotels, entertainment, eco and extreme tourism facilities.

## Valuation based on the Resource Rent method

### Resource Rent method

The Resource Rent (RR) method is often highlighted as an appropriate method to be used for ESs valuation (Badura et al. 2017). The RR is constituted as the difference between the total revenue of the production and the cost of labour, intermediate inputs and produced assets (UN et al. 2014). The outcome of the RR, also called a residual, represents the value of the ecosystem services. RR is consistent with exchange values, as it reflects the return to an ecosystem asset that is consumed in the production of goods or services (Obst et al. 2015). However, certain conditions apply to calculate the value of ecosystem services using the RR. It is assumed that the resource is “extracted or

harvested sustainably and that the owner of the resource seeks to maximise his or her resource rent" (UN et al. 2014).

In the SEEA-EA standard, the resource rent is mostly associated with provisioning services and it is possible to use this method as a proxy for the monetary value of the services (UN et al. 2014). The Technical recommendations in support of SEEA-EA provide a broader implementation of RR use. The document states that, besides the provisioning services, the RR is also applicable to value cultural services (UNSD 2017). For measures in monetary terms, the costs of providing the service usually are taken into account. For example, maintenance work in a natural park, like waste cleaning and restoring the walking paths, can be associated with human input and capital costs. If ecosystem services can be linked to market prices, like recreation and tourism, the required information for valuing the services is available in the national accounts.

Two economic sectors benefit financially from recreation: accommodation and catering, such as food/drinks serving in restaurants and cafes. We have estimated the output of sales, intermediate costs, labour cost and cost of fixed capital for accommodation and catering services in the UCNP.

The resource rent formula (Asafu-Adjaye 2005) was used for calculation:

$$RR = TR - (IC + LC + FC)$$

where TR is total revenue, IC is intermediate costs, LC is labour costs and FC is fixed costs, user costs or produced assets.

### Data collection and analysis for resource rent

For our research, statistical data regarding accommodation and catering services were obtained from the Statistics Agency under the President of the Republic of Uzbekistan (Uzstat). The relevant accommodation and catering services were selected, based on their location in the Bostanlik Region using the statistic code of the region 1727224. The data included information about net revenue, cost of providing services, expenses of the period, operating income, income tax, profit and net income of 64 hotels, two short-stay houses for weekends, 18 tourists, leisure and entertainment camps and two other accommodation services. The food/drinks serving included 59 restaurants, cafes and four food and drinks delivery services at the UCNP. It is worth mentioning that Uzstat possesses limited data from the UCNP and not all necessary information is available, such as entertainment cost in the Park.

## Valuation based on the Travel Cost method

### Travel Cost method

First presented by Harold Hotelling in 1947 and further developed by Trice and Wood (1958) and Clawson (1959), the travel cost method (TCM), used in environmental

economics, is a way to estimate the monetary value of recreational ecosystem services (Garrod and Willis 1999, Asafu-Adjaye 2005). The idea behind the TCM is that consumers express the value they attribute to a site through the trip expenses (transportation costs, travel time, park entrance fee) that they are willing to pay to visit the site (Graves 2013). However, it is important to pay attention in which context and for what purpose the TCM is used. Following the two interpretations by Garrod and Willis (1999), we estimate consumer expenditure (CE) and construct the demand curve and the estimate of the consumer surplus. The remainder of this section describes the TCM in the second interpretation.

The TCM method can be applied using a single site or a multiple site approach (Rosenthal et al. 1984, Parsons 2003). The single site approach is straightforward and is suitable when the specific site under consideration holds particular interest and significance. The single site approach operates similarly to traditional downward-sloping demand functions. In this context, a number of trips made to a specific site corresponds to the “quantity” unit and the cost associated with travelling to the site relates to the “price” unit. The variation in price is introduced by examining individuals residing at different distances from the site, resulting in lower prices for those closer and higher prices for those further away. The single site approach encompasses the Zonal Travel Cost Method (ZTCM) and Individual Travel Cost Method (ITCM) variations of the TCM (Haab and McConnell 2002). The ZTCM is applied by collecting data on the number of visits to the site from various distances.

This method categorises the overall region from which visitors come into a set of visitor zones. Through the comparison of the cost of travel from a particular zone with the corresponding number of visitors and the population of the zone, one can chart a point for each zone. Subsequently, a curve can be fitted to all these points, creating the demand curve from which a measure of consumer surplus can be derived (Smith and Kopp 1980, Smith and Kaoru 1987, Asafu-Adjaye 2005). The ITCM is similar to the zonal approach, but employs survey data from individual visitors in the statistical analysis instead of utilising data from each zone (Daly and Farley 2010, Tobarra-González and Mendoza-Monpeán 2018).

The multiple site approach is applicable when the researcher seeks to assess the worth of alterations in site characteristics at one or more sites or when valuing simultaneous access to multiple sites. The Random Utility Model (RUM) stands out as the extensively employed model for multiple site assessments (Boyle 2017). The RUM is the most intricate and resource-intensive amongst the travel cost approaches. It proves most effective when valuing specific characteristics or quality changes within sites rather than assessing the site as such. Additionally, it is the preferred method when dealing with numerous substitute sites.

In case of our study, substitute sites are not considered, as we focus on a single national park within the region, specifically the one closest to the capital and its surrounding area. As described earlier in the case study section, Zaamin National Park cannot be regarded as a viable alternative to UCNP. For residents of the capital, the distance to this Park is

263 km, requiring a 5-hour one-way drive. Therefore, for this study, we apply the single site approach, using the Individual Travel Cost Method (ITCM). The adoption of this approach is grounded in the following considerations: (1) ITCM, despite requiring more extensive data collection and a somewhat more complex analysis, is expected to yield more precise results (Fauzi 2006), (2) Bowker et al. (2015) advocate for ITCM over ZTCM, citing reasons such as statistical efficiency, theoretical modelling consistency in behaviour, avoidance of arbitrary zone definition and increased heterogeneity amongst populations within zones, (3) lastly, the challenge of distinguishing between visitors and zones in our case study, particularly with a predominant visitors' rate from the capital and its vicinity, renders ZTCM unsuitable for application.

The ITCM estimates the demand curve from the number of visits made by an individual to the site. The number of trips that an individual will take is a function of the travel costs and social-economic characteristics such as age, gender, education level, employment status, income and perceived quality of the site by individual (Garrod and Willis 1999).

The quality of the site is reflected in the cleanliness and site maintenance, factors that can impact individual preferences for visiting the site more or less frequently (Sohngen et al. 2000, Parsons 2003).

The function of the ITCM is presented as follows:

where $Ti$ indicates the number of trips by individual $i$; $Ci$ indicates the travel costs of individual $i$; and $Xi$ denotes a vector of individual characteristics of individual $i$.

Usually, travel costs include direct transportation costs, such as train tickets or fuel use, the opportunity cost of the time spent for travelling, expenses on food and accommodation and other costs associated with a visit to the site. The opportunity cost of time, or travel time costs, is an uncertain variable for TCM. Scholars are divided on whether these costs should be included or not in travel cost calculation (Smith et al. 1983, Zhang et al. 2015, Borzykowski et al. 2017). In our research, we excluded the travel time costs from the calculation.

We analysed the data by a count data model. The count data model assumes that the number of trips made to the Park by any individual ($r_i$), which is a non-negative integer, follows a Poisson distribution. The probability density function ($Pr$) for this distribution is based on Haab and McConnell (2002) and Perman et al. (2011):

with

where denotes ...; $C_i$ denotes the travel costs of individual $i$; $X_1 \ldots X_n$ are individual characteristics; and and are coefficients.

Given that the conditional mean of the Poisson distribution is equal to the parameter , the expected trips for any given price, age, is given by:

To calculate the consumer surplus ($CS$) for each visit, the demand curve is integrated between the limits of the current travel cost and infinity:

Given the expected negative value for , the expression for the consumer surplus is:

This makes the total consumer surplus for recreational services at the Park:

## Data collection and analysis for travel cost method

The survey for TCM consisted of 22 questions, formed in three parts: general, main and personal. The general part elicited the origin of the visitor, the purpose of visit and destination, frequency of visit, the duration and travel time. The main part elicited the expenses for travel and stay in the Park. The personal part concluded with questions about visitor's gender, age, education level and income and perceived quality of the Park. The quality of the Park, encompassing cleanliness and maintenance, is considered subjective and varies amongst individuals rather than being inherent site characteristics. Respondents were asked to rank on a scale from 1 to 5 (1 = no influence at all, 5 = very high influence) their perception if the Park's quality influences their decision to visit. To estimate the travel costs, the costs of fuel, accommodation, entertainment and food costs were obtained from respondents (see Suppl. material 1). The fuel cost includes round-trip consumption.

The survey was conducted from August till October 2018. In personal surveys, with the support of two instructed interviewers, the respondents were randomly approached in four spots in the UCNP (Panoramic view at Charvak Reserve, Bochki, Piramidi resort, Chimgan cableway). Respondents were chosen with the minimum age of 16, in order to ensure the correct and full understanding of all questions. The surveys were completed by the respondents, with the interviewer's presence nearby. If the respondent had difficulty reading the questions or understand them, the interviewer provided support. In addition, the main aim of the interviewer was to make sure that all the questions were answered, while providing freedom of choice if the respondent was unwilling to answer. In total, 600 responses were collected.

Respondents could provide the answer indicating the fuel cost either in money equivalent they paid or in amount (litre) they used. In the second case, the amount was converted to monetary value using a fuel price of US$ 0.48 per litre. This price is an average fuel price in Uzbekistan, registered in 2018 (CMRU Resolution #913 2017). For the international respondents, who came by air, only their round trip transport cost (taxi) from Tashkent and to the Park was considered. This is to avoid the costs associated with multiple purposes of visit, like travelling to other touristic places in Uzbekistan. The accommodation cost was provided by respondents who stayed multiple days in the Park or at least one night. We surveyed entertainment and food costs, as for the one-day travellers, these expenses will be high.

## Valuation based on Simulated Exchange Value

### Simulated Exchange Value method

Caparrós et al. (2003) introduced the Simulated Exchange Value (SEV) method, which aims to simulate prices in situations where direct market prices or prices from comparable markets are unavailable, such as in the case of free-access nature-based recreation ( Caparrós et al. 2003, Campos and Caparrós 2009). This approach utilises the supply (cost) and demand (estimated through non-market valuation) functions of the analysed ESs to calculate their potential output exchange value (price multiplied by quantity) at a specific point along the demand curve (Oviedo et al. 2010). Caparrós et al. (2003) and Campos and Caparrós (2009) used the SEV method for two potential market solutions: monopoly and perfect competition.

Exploring the concept of establishing a hypothetical market for CESs, particularly focusing on recreational services of UCNP, we decided to experiment and combine the TCM and SEV approaches. In this case, the TCM was used in the second interpretation, as described in section Travel cost method. The demand curve was constructed, based on travel costs and the visitation rate. As the National Park's maintenance costs are independent of the number of visitors, the marginal cost of a visit is zero, resulting in a flat supply curve at P = 0.

As the number of recreational areas are fixed in Uzbekistan and UCNP is the only closest park to the capital, conditions applied to a market with monopolistic competition were considered in simulation. The goal of the simulation was to find the entrance park fee amount that maximises revenue. As a baseline, we used the survey data and Poisson distribution from ITCM.

The Poisson count data model estimates the following demand function:

where $T$ is the expected number of trips; are coefficients; $C_i$ denotes the travel cost; $F_i$ denotes the park fee; $A_i$ denotes the respondent's age; $Gi$ denotes the respondent's gender; $Ei$ denotes the respondent's education; $Ji$ denotes the respondent's job status; $Ii$ denotes the respondent's income and $Qi$ denotes the perception of quality of the Park. Keeping the number of visitors constant, the park fee $F^*$ that maximises total park revenues is equal to the park fee that maximises park revenues per visitor:

Hence the park fee is defined by the first-order condition:

Considering that the term $e^x$ is by definition positive this expression is solved by:

It is important to point out that the expression for maximum revenue is the same as for total CS. That is a characteristic of this model.

The hypothetical revenue from market transactions was taken as a measure of ecosystem services value. To calculate the total revenue of the Park, the total number of park visits data should be available.

### Data collection and analysis for SEV

As the basis for the SEV was formed upon the TCM, the data were already collected in the TCM approach. Additional data collection was not required for further analysis.

Following the consistency of TCM survey data, we applied the visitor's categorisation, based on their origin and duration of visit (Tashkent citizens ODT and MDT; Domestic citizens ODT and MDT). International visitors were excluded from the model. Considering four types of visitors, four models were designed and tested. The sample size of the visitors was according to the ITCM respondents' sample in the section Results based on travel cost method.

## Valuation based on Consumer Expenditure method

### Consumer Expenditure (CE) method

The Consumer Expenditure (CE) method is employed in numerous studies to assess the value of ecosystem services associated with tourism and recreation activities. Ruiz-Frau et al. (2013) evaluated the economic significance and spatial distribution of non-extractive uses of marine biodiversity in the coastal temperate area of Wales. This is accomplished by computing the total annual expenditure linked to recreational services. The study determines the average expenditure per person per day for various activities, encompassing costs related to food and drink, accommodation, travel and additional expenses for equipment usage. Horlings et al. (2019) showed the experimental results of valuing cultural ecosystem services in monetary terms in the Netherlands. In the report, the CE method is used for valuing ecosystem services that contribute to tourism and recreation activities. The authors claim that visitors benefit in the first place from CES, while tourism businesses serve as secondary beneficiaries. By definition, CES are directly provided to people through recreation, knowledge development, relaxation and spiritual reflection (UN 2021). The synergy between the ecosystem's contribution to recreation and human-managed inputs, such as hotels, restaurants and entertainment, collectively generates recreational benefits. The assertion here is that, without the ecosystems and the CES they provide, these consumer expenses would not occur. For example, individuals visiting the UCNP view food and drinks as integral to their recreational experience. They are willing to spend more money to enjoy meals at cafes or restaurants situated within the Park's natural surroundings. Certain respondents expressed the intention to purposefully visit the Park for lunch during weekends rather than staying at home. Ideally, the difference between the cost of food in visitors' residential areas and the cost of food in the Park would reflect the value of nature, signifying the value of CES. However, this aspect is not part of our research.

Similar to the TCM, ongoing discussions persist regarding the inclusion of specific consumer expenditure types to value ESs (Blaine et al. 2015, Ricardo Energy & Environment (REE) 2016, Pelletier et al. 2021, Che 2022). These discussions are essential, as decisions regarding the incorporation or omission of various expenditure items profoundly influence the associated value estimates or the value of the ecosystem service. Therefore, Horlings et al. (2019) encompassed both single-day and multi-day activities experimenting with three types of expenditure (limited, medium, broad) reflecting a different set of payments (ranging from including only entrance fees and travel costs in the limited approach to all expenditure in the tourism sector that can be related to ecosystem visits in the broad approach).

In our study, the CE method for valuing recreational services in the UCNP utilises the same data associated with recreational activities that was gathered for TCM in the first interpretation. The expenditure categories related to recreational activities, for instance travel cost to and from the Park, accommodation, food and entertainment costs, were selected. To address the range of expenditure, two types, basic and full packages for visitors engaging in one-day trips and multiple-day trips were tested.

### Data collection and analysis for CE

Data for the CE method were obtained from the TCM survey. The details of the survey were presented in section Data collection and analysis for travel cost method. From the survey, the expenditure of respondents visiting the recreational park were received.

## Estimating the number of park visits

Due to the lack of information about the number of Park`s visitors, we have made an estimation based on quantitative data collection.

We estimated the number of visitors by counting cars that passed the entrance of the Park at the allotted time, following the approach of O'Brien and Morris (2010). The 10 minutes interval by three repeats during the morning (M), afternoon(A) and evening(E) hours were selected for counting. We considered the M interval from 9:00-13:00 h (4 hours), the A interval from 13:00-17:00 h (4 hours) and the E interval from 17:00-20:00 h (3 hours). Secondly, the average number of cars during the M-A-E was extrapolated to 1 day. Thirdly, counting was performed during two weekend days and two weekdays. Assuming that the summer period lasts from 1 June till 1 September, which includes 66 weekdays and 27 weekends, we extrapolated the one-day data to the summer season. Fourthly, we requested information from the UNCP administration regarding the seasonal proportion of Park's visits. From the seasonal proportion and extrapolated data for the summer period, we obtained the total number of annual visits. Finally, using the proportion of respondents type in the ITCM survey, we categorised the total number of Park's visits.

# Results

## Results based on resource rent method

According to the statistical data provided by the Uzstat, the total revenue of accommodation service was US$ 3.702M and food-drinks serving was US$ 1.434M in 2018. It is crucial to emphasise that unreported accommodation are deemed illegal and are not included in these services. The sum of IC, LC and FC were US$ 2.598M for accommodation and US$ 0.919M for food-drinks serving in 2018 (see Table 1). The interest rate of 12.6% was applied for the return of fixed capital according to Uzbekistan Central bank lending rate in 2018*[2].

Table 1.

Accommodation and catering services in the Bostanlik Region of Tashkent Province in 2018 (in US$ million).

| Type of economic activity | Total revenue (TR) | Intermediate, labour and fixed capital costs (IC+LC+FC) | Resource Rent (RR) |
|---|---|---|---|
| **Accommodation and food-drinks serving** | **5.136** | **3.516** | **1.621** |
| **Accommodation services , of which**: | **3.702** | **2.598** | 1.106 |
| Hotels and similar accommodation | 0.851 | 0.478 | 0.373 |
| Short-stay accommodation for weekends | 1.743 | 1.241 | 0.502 |
| Tourist, leisure and entertainment camps | 1.105 | 0.877 | 0.228 |
| Other accommodation services | 0.0037 | 0.002 | 0.0017 |
| **Food-drinks serving , of which**: | **1.434** | **0.919** | 0.515 |
| Restaurants and Food Delivery Services | 1.225 | 0.800 | 0.425 |
| Custom food delivery and other food delivery services | 0.153 | 0.077 | 0.076 |
| Drinks serving | 0.057 | 0.042 | 0.015 |

The recreational service in the UCNP was valued as the resource rent generated by the accommodation and catering services in the Park. The total revenue (TR) for the accommodation and catering services was estimated at US$ 5.136M in 2018. The sum of intermediate costs, labour and fixed capital costs for both of the services were US$ 3.516M. According to calculation (using the resource rent formula in section Resource rent method), the resulting resource rent for UCNP recreation was US$ 1.62M. in 2018.

## Results based on travel cost method

Based on the results of the survey, the respondents were categorised upon the place of arrival. If the respondents arrived from the capital (Tashkent), we defined them as “Tashkent citizens”; if respondents visited the Park from other regions of Uzbekistan, we defined them as “Domestic citizens”; if they came from abroad, they were defined as “Internationals”. Additionally, the respondents were categorised according to their purpose of visit: single or multiple. Visitors who stayed multiple days at the Park were grouped as Multiple Day Trip (MDT), the rest of the people, who made a short trip, were grouped as One Day Trip (ODT) visitors. Further, as a target interest group for this research, we considered only respondents with a single purpose visit. The multiple purpose visits were excluded, as the analysis focused on the travel cost, which represents the peoples` willingness to pay for the trip to visit the Park. Moreover, Internationals were excluded, as the number of respondents was relatively small compared to other groups and the preliminary results showed no significance in variables.

As the result of categorisation, the proportion of respondents was as follows: 77% Tashkent citizens and 16% Domestic citizens. Table 2 provides an overview of the respondents' categorisation.

Table 2.

Number of respondents by type of trip (single purpose versus multipurpose and one-day trip (ODT) versus multiple-day trip (MDT).

| Respondents origin | Number of respondents | Single purpose visit | | | Multiple purpose visit |
|---|---|---|---|---|---|
| | | Total | One Day Trip (ODT) | Multiple Day Trip (MDT) | |
| Tashkent citizens | 461 | 456 (77%) | 165 | 291 | 5 |
| Domestic citizens | 98 | 96 (16%) | 35 | 61 | 2 |
| Internationals | 41 | 41 (7%) | 22 | 19 | 0 |

By excluding Internationals and multiple purpose visit respondents, the final sample constituted 552 completed responses.

The descriptive statistics of social-economic features of UCNP visitors showed that the most visiting age range of the respondents was 26-35 years in all respondent categories (see Fig. 2). According to Fig. 3, more than 50% of the respondents had a university degree, except for domestic citizens (ODT), where the majority had a college degree. The monthly income level of highly educated respondents was between US$ 150- US$ 250 for Tashkent and Domestic citizens (see Fig. 5). More than 50% of the visitors were male (see Fig. 4).

Taking into account the significance of variables in different combinations, we have tested two models for each type of respondents. Model 1 included all variables, while Model 2

counted only significant variables. Due to the strongest relationship between the significant variables, we considered Model 2 more appropriate for our research.

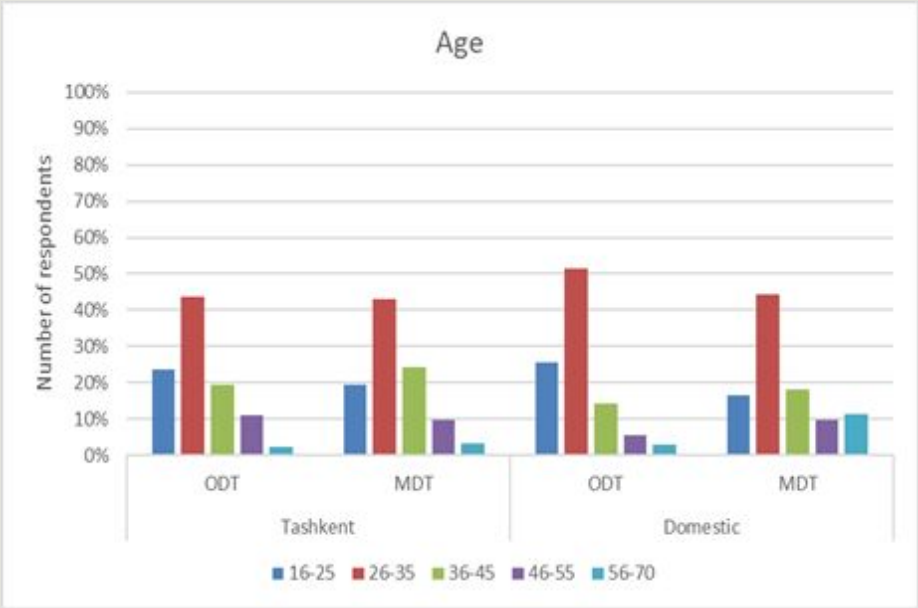


Figure 2.

Respondents' age*[3].

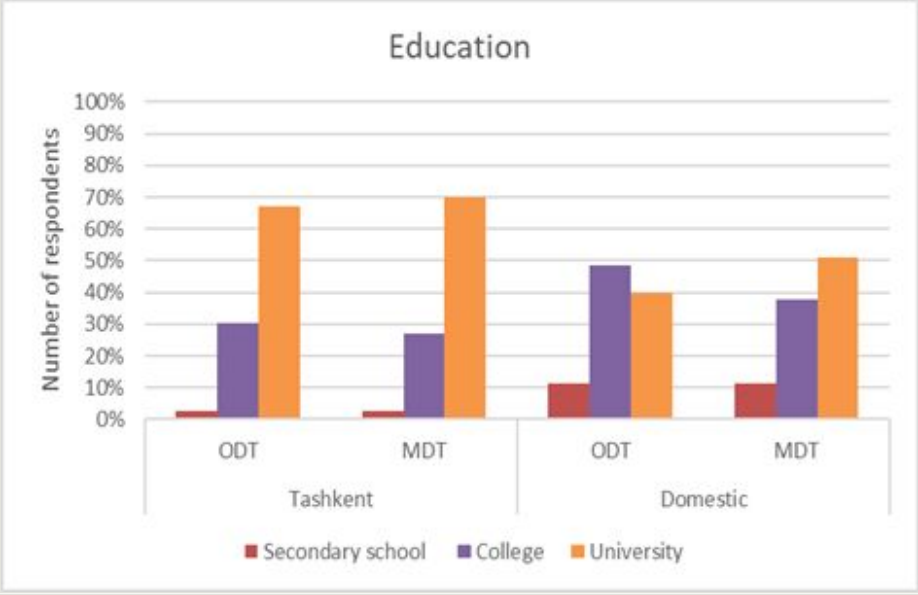


Figure 3.

Respondents' education.

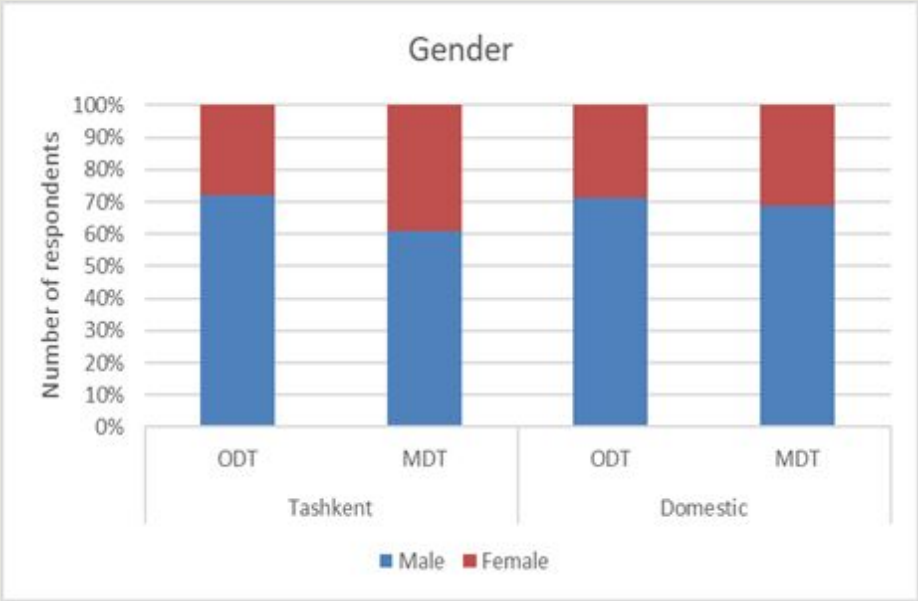


Figure 4.
Respondents' gender.

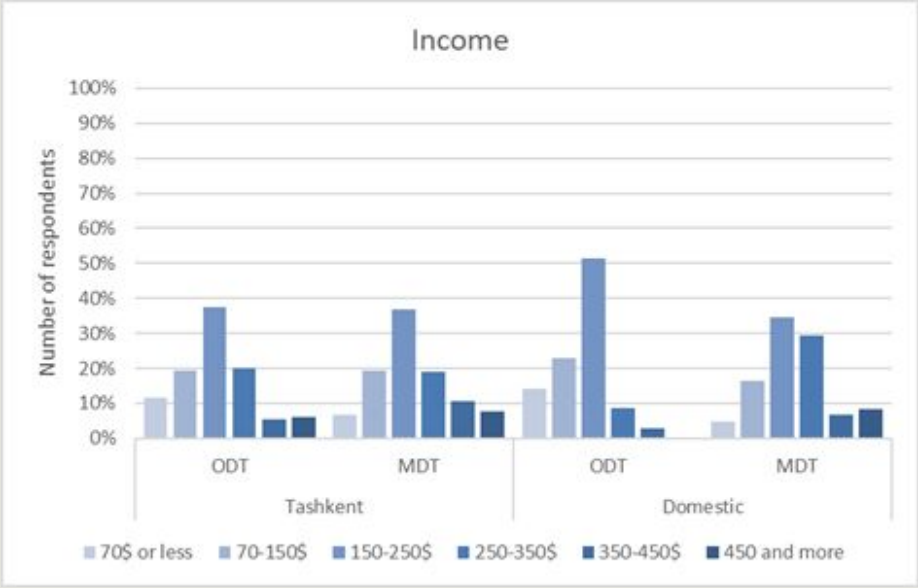


Figure 5.
Respondents' income.

In Model 2, two out of seven explanatory variables of ODT Tashkent citizens were statistically significant (Travel cost and Age) with a p-value below 0.05. For MDT Tashkent

citizens, five variables had a p-value of less than 0.01 (Travel cost, Age, Gender, Job status and Income), while for Domestic ODT and MDT visitors, only Travel cost had a p-value below 0.001. All variable coefficients of travel cost had a negative sign, which conforms with the reasonable expectation that the number of visits declines with travel costs. Table 3 shows the results of the Poisson model used to estimate the travel cost function.

Table 3.

Results of the Poisson model with travel cost variables.

| Variables | Tashkent citizens (n = 456) | | | | Domestic citizens (n = 96) | | | |
|---|---|---|---|---|---|---|---|---|
| | ODT (n = 165) | | MDT (n = 291) | | ODT (n = 35) | | MDT (n=61) | |
| | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 | Model 1 | Model 2 |
| (Intercept) $\beta_0$ | 1.92418*** (0.34008) | 1.72983*** (0.17677) | 2.30245*** (0.20368) | 1.52974*** (0.11569) | 1.79369** (0.65545) | 2.01143*** (0.15262) | 1.42704** (0.50587) | 1.33994*** (0.13160) |
| Travel_cost $\beta_1$ | -0.01752** (0.00586) | -0.01859** (0.00579) | -0.00570*** (0.00155) | -0.00559*** (0.00156) | -0.06389*** (0.01605) | -0.06874*** (0.01414) | -0.01056** (0.00321) | -0.01073*** (0.00299) |
| Age $\beta_2$ | -0.01305* (0.00512) | -0.01240* (0.00484) | 0.01079*** (0.00264) | 0.01065*** (0.00263) | -0.00643 (0.01483) | | -0.00336 (0.00813) | |
| Gender $\beta_3$ | -0.04015 (0.10176) | | -0.15159** (0.05838) | -0.18869** (0.05751) | 0.04825 (0.27886) | | 0.03757 (0.18457) | |
| Educat $\beta_4$ | -0.05801 (0.08765) | | -0.11656* (0.05206) | | 0.01897 (0.15002) | | -0.04428 (0.12199) | |
| JobStat $\beta_5$ | -0.07043 (0.12839) | | -0.32411*** (0.08023) | -0.28276*** (0.07941) | 0.01005 (0.28360) | | -0.18518 (0.27236) | |
| Income $\beta_6$ | 0.00053 (0.00034) | | 0.00078*** (0.00022) | 0.00056** (0.00021) | 0.00094 (0.00106) | | 0.00074 (0.00063) | |
| Quality $\beta_7$ | -0.02480 (0.04499) | | -0.12732*** (0.02694) | | -0.07581 (0.06661) | | 0.01210 (0.09149) | |
| λ | | 3.1 | | 4.8 | | 3.6 | | 2.49 |
| CS per trip (US$) | | 53.78 | | 166.78 | | 14.54 | | 93.13 |
| *Confidence Interval (CI) 95%* | | [*33.40, 138.09*] | | [*110.3, 341.9*] | | [*10.37, 24.37*] | | [*60.24, 205.2*] |
| **Significance: 0 '***'0.001 '**'0.01 '*'0.05'.'(…) – std.error** | | | | | | | | |

At this point of the research, we have obtained the necessary results to continue with the next method of valuing recreational services in the UCNP. However, being interested in the outcome of the ITCM, we finalised calculating the consumer surplus. Thus, according to Table 3, the consumer surplus per trip per person equals for Tashkent citizens US$ 53.78 (ODT) and US$ 166.78 (MDT), for Domestic citizens US$ 14.54 (ODT) and US$ 93.13 (MDT).

Multiplying the CS per trip per person by the number of Park's visits will provide an annual CS. The annual CS will represent the total benefit of recreation in nature. In our research, the calculation of the annual CS is presented in Suppl. material 2.

## Results based on simulated exchange values

The results of the simulated park fee have provided four outcomes, as the model was tested for four types of respondents. In Table 4, we can see the park fee ($F^*$) that maximises park revenues per visitor. Considering that the count-data model for CS and SEV is mathematically equal, the outcome parameters for the CS per trip per visitor and simulated park fee per visitor are equal as well.

Table 4.

The results of simulated park fee entrance (per visitor).

| Parameters | Tashkent citizens | | Domestic citizens | |
|---|---|---|---|---|
| | ODT | MDT | ODT | MDT |
| Park fee (in US$) per visitor | 53.78 | 166.78 | 14.54 | 93.13 |
| Confidence interval (CI) 95% | [33.40, 138.09] | [110.3, 341.9] | [10.37, 24.37] | [60.24, 205.2] |
| Max revenue per visitor (in US$) | 62.38 | 300.2 | 19.62 | 84.74 |
| Number of trips max. revenue per visitor | 1.16 | 1.80 | 1.35 | 0.91 |

Fig. 6 presents four plots of visitors types with the park fee at the maximum revenue per visitor.

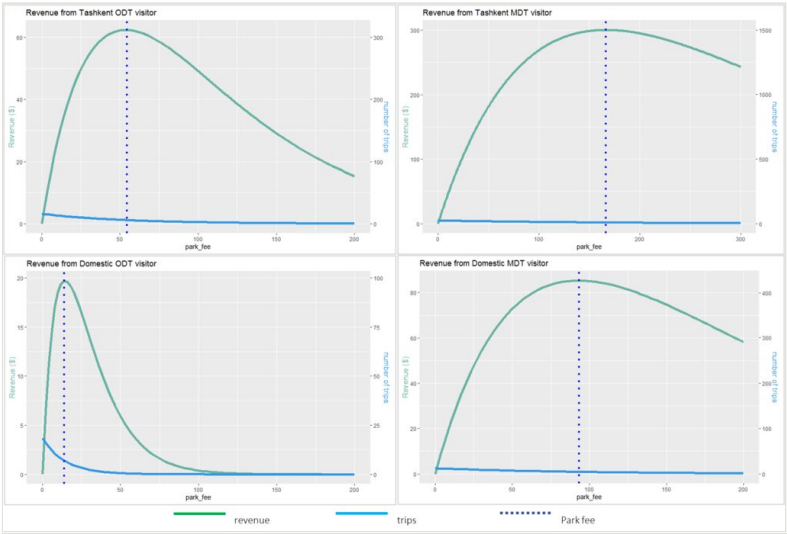


Figure 6.

Revenue, park fee and number of trips for four types of visitors (per visitor).

The total revenue of the Park is measured by multiplying the park fee on the total number of park's visits using the correction to the number of trips maximising the revenue and number of trips by sampled respondents. The calculation is presented in Suppl. material 3.

## Results based on consumer expenditure

In our research, we have selected expenditure categories related to recreational activities, for instance, travel cost to and from the Park, accommodation, food and entertainment costs. Considering the scope of the expenditure, the basic and full packages were formed for ODT and MDT visitors. Table 5 shows what expenditure categories are included in each type of package.

Table 5.

Expenditure categories included in the packages for a different type of visitors.

| ODT visitors | | MDT visitors | |
|---|---|---|---|
| Basic package | Full package | Basic package | Full package |
| -cost of fuel | -cost of fuel<br>-food<br>-entertainment | -cost of fuel<br>-accommodation | -cost of fuel<br>-accommodation<br>-food<br>-entertainment |

The data provided by the respondents in the survey (see section Results based on travel cost method and Suppl. material 1) were grouped by the respondents' type and the scope of their expenditure. The results of the consumer expenditure per visit are presented in Table 6.

Table 6.

Results of the consumer expenditure by scope and respondents type.

| Package | Tashkent citizens | | Domestic citizens | |
|---|---|---|---|---|
| | ODT | MDT | ODT | MDT |
| Basic (per visit in US$) | 2.63 | 19.69 | 2.54 | 37.68 |
| Confidence interval 95% for Basic | [2.37, 2.89] | [17.69, 21.68] | [2.35, 2.74] | [28.19, 47.18] |
| Full (per visit in US$) | 10.27 | 28.40 | 11.25 | 46.50 |
| Confidence interval 95% for Full | [8.94, 11.61] | [25.85, 30.94] | [10.25, 12.25] | [36.16, 56.85] |

## Results based on estimated park's visits

### Estimating the number of visits

For estimating the number of park visits, we have obtained information about the number of cars passing in 10 minutes range in a specific period of daytime (see Table 7).

Table 7.
Number of cars driving into the Park.

| Date | Type of the day | Time | Number of passing cars in 10 min (average for the timeslot) | Average passed cars in 10 min (for the type of the day) | Date | Type of the day | Time | Number of passing cars in 10 min | Average passed cars in 10 min |
|---|---|---|---|---|---|---|---|---|---|
| 25-26.08.18 | weekend (M) | 10:15-10:25 | 42 | 45 | 28-29.08.18 | weekday (M) | 9:30 – 9:40 | 28 | 25 |
| | | 10:25-10:35 | 44 | | | | 9:40-9:50 | 23 | |
| | | 10:35-10:45 | 48 | | | | 9:50-10:00 | 24 | |
| | weekend (A) | 13:23-13:33 | 32 | 30 | | weekday (A) | 14:20-14:30 | 15 | 16 |
| | | 13:33-13:43 | 27 | | | | 14:30-14:40 | 18 | |
| | | 13:43-13:53 | 30 | | | | 14:40-14:50 | 14 | |
| | weekend (E) | 18:30-18:40 | 8 | 6 | | weekday (E) | 18:10-18:20 | 7 | 5 |
| | | 18:40-18:50 | 4 | | | | 18:20-18:30 | 5 | |
| | | 18:50-19:00 | 5 | | | | 18:30-18:40 | 4 | |

M – morning; A – afternoon, E – evening.

The observation was conducted over two weekend days and two weekdays.

Assuming that morning visit hour starts from 9:00 h till 13:00 h (4 hours), afternoon hours from 13:00 h till 17:00 h (4 hours) and evening hours from 17:00 h till 20:00 h (3 hours), we have extrapolated the average number of passing cars per 10 min to visiting hours, differentiating for weekdays and weekends. This extrapolation is presented in Fig. 7.

Although this extrapolation introduces considerable uncertainty, the study lacks sufficient observations to provide a meaningful analysis of the standard deviation. Due to the limited data available, we believe it is not feasible to accurately assess and incorporate this uncertainty.

Assuming the summer season 2018 lasted from 1 June till 1 September, which is 66 weekdays and 27 weekends, we obtained the total 122,400 cars in the summer period. We suppose that the car driver was accompanied on average by two people. Thus, the number of summer visits is 367,200. According to the interview with the UCNP

administration, the seasonal visits to the Park are spread accordingly: winter – 20%, spring – 15%, summer – 60% and autumn – 5%. This means that the total number of assumed visits in 2018 is approximately 612,000. Using the proportion of respondents type in the survey from Table 2, we categorise the total number of park visits (see Table 8).

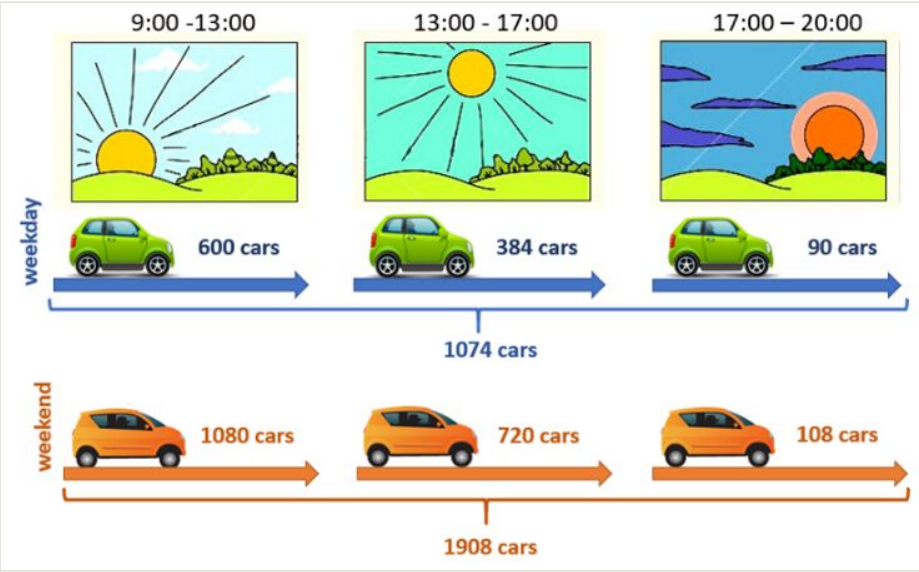


Figure 7.

Extrapolation of the total number of cars.

Table 8.

The estimated number of park visits categorised by respondents type.

| Total number of estimated visits (thousands) | Tashkent citizens (77%*), in thousands | | Domestic citizens (16%*), in thousands | |
|---|---|---|---|---|
| | ODT (37%) | MDT (63%) | ODT (36,5%) | MDT (63,5%) |
| **612** | 174 | 297 | 36 | 62 |

*the rest 7% of estimated visitors are international visitors that are not considered in this research.

## Overall results

Table 9 shows the results of all four methods implemented to value recreational services in the UCNP.

In the case of RR, the annual visitation figures are implicit in the statistical data, whereas the ITCM, SEV and CE approaches use estimates for yearly park visits as presented in Table 8 to estimate the total value of recreational services in the Park. The detailed calculations are provided in Suppl. materials 2, 3, 4.

Table 9.
The value of recreational service in the UCNP, based on different calculation methods.

| Method | The value of recreational service (in M US$) in 2018 |
|---|---|
| RR | 1.62 |
| ITCM (total CS) [CI 95%] | 65.19 [42.66, 139.09] |
| SEV (total revenue) [CI 95%] | 24.46 [15.99, 52.21] |
| CE basic [CI 95%] | 8.74 [7.48, 9.94] |
| CE full [CI 95%] | 13.50 [11.82, 15.16] |

## Discussion

This paper presented four valuation approaches for recreational services provided by the Ugam Chatkal State Nature National Park (UCNP). According to these approaches, the recreational service value of the Park is between US$ 1.62M and US$ 65.19M annually. This significant difference in value is a result of different accounting methods.

The resource rent (RR) approach resulted in the lowest recreational value, neglecting additional non-market recreational values that the Park probably offers. This was expected, as RR only included direct revenues based on food and accommodation expenditure. Furthermore, the calculation of accommodation revenue may potentially underestimate the actual revenue, as it does not account for illegal or unreported revenues. It confirms the statement of the SEEA-EA concept (UN et al. 2014, 5.77) that "the resulting estimates of the resource rent approach understate the "true" value of ecosystem services in terms of capturing all of the relevant missing prices". The advantage of the RR approach is that the outcome is consistent with exchange values (Obst et al. 2015) and can be reflected in national accounts. The SEEA-EA concept recognises this advantage. Nevertheless, it is but one of many alternative approaches to estimate the value of an ecosystem service (UN et al. 2014, 5.83). The recreational value of the UCNP that is based on RR can be considered a lower bound to the value of the recreational services of the Park.

The highest value was found using the TCM to calculate the consumer surplus (CS). This is expected since the TCM includes the CS and incorporates both market and non-market values, unlike the RR method. The market values of the Park are presented in the form of travel, accommodation, entertainment and food costs. By calculating consumer surplus, this method captures the non-market recreational value of the Park. This way, the TCM is showing the maximised value of recreational service in the UCNP.

The study utilised the single-site approach, employing the Individual Travel Cost Model (ITCM) to analyse four respondent categories visiting the Park: Tashkent and Domestic citizens, classified as either one-day or multiple-days travellers. The possibility of substitute sites is not taken into consideration, as the next best site is the Zaamin National

Park park at 263 km distance, which makes it hardly a credible substitute for UCNP. Analysis of each respondent type showed a negative relationship between the frequency of visit and travel costs. These findings are consistent with the research of other authors, for example Zandi et al. (2018) in Iran and Menendez-Carbo et al. (2020) in Ecuador. The research revealed that the Tashkent citizens with multiple day visits have the highest frequency of visits to the Park. Additionally, the CS is presented as the highest, around US$ 166.78 per trip. This can be explained due to several reasons: the UCNP is the closest natural park to the capital; people from the capital have higher income and prefer more luxurious stays at the hotels with the price range US$ 100- US$ 200 per night; people want to spend their weekends and holidays in nature, especially in summer; longer stays in nature are preferred. The results of high CS is consonant with the research of Ezebilo (2016), who revealed that the CS for a recreational trip is more than four times higher than the calculated total travel cost. According to Ezebilo (2016), the respondents obtain greater benefits from recreation than the costs associated with the recreational trip. Tashkent and Domestic citizens with one day trips are identified as the next most frequent visiting group. The expenses for these types of visitors are considerably lower, as accommodation is not required. This group likely contains a lot of people living in close vicinity to the Park, but outside of Tashkent.

Using the TCM to calculate simulated exchange values (SEV) results in a recreational service value of the Park at US$ 24.46M. This value is lower than the CS, but higher than RR. It is expected, as setting an exchange value will exclude the group of consumers for whom the exchange value is higher than their personal added value, while only capturing part of the CS of the group of consumers that will engage in the exchange. This method used the same demand function as the one used for calculating the CS. This means that the same expenses are captured in both methods. The exchange value of the Park was calculated by simulating the entrance fee that would yield the highest park revenue. Contrary to CS, the SEV of the Park can, in principle, be captured and, therefore, be considered a more realistic approximation of the value of recreational services in UCNP. By simulating the entrance park fee, we create a hypothetical market for recreational services. It means that a consistent price for recreational ecosystem services is derived that would be realistically implemented if a market existed for recreational service in UCNP.

Using CS in this context would imply that each visitor pays the maximum amount they are willing to pay to visit the Park (Barton et al. 2019). This assumption is potentially strong for simulating a market and deriving an exchange value (London Group on Environmental Accounting (LGEA) 2002, Caparrós et al. 2003). The exchange value assumes that, on average, all buyers pay the same price (UN et al. 2014, Scheufele and Pascoe 2023).

The research confirms that the proposition of Caparrós et al. (2017) that the TCM, which estimates a Marshallian demand function, could be used to simulate exchange values. According to the research outcome, the TCM is applicable within the SEEA-EA concept as consumer surplus and cost of time was not used. Moreover, since SEV has a high potential to be incorporated within the SEEA-EA, this research contributed to additional investigation and exploration of the SEV potential. Considering the applicability of the

method, our research provides strong support for the statement of the SEEA-EA concept and Obst (2018) about the possibility of using the information on expenditure, such as travel cost, to estimate demand for specific ecosystem services, particularly cultural services.

Garrod and Willis (1999) proposed two ways of interpreting the TCM, either to consider the actual travel costs data as a value of services or use the demand curve to calculate the consumer surplus. However, in the case of our research, the demand curve from TCM was used to simulate the exchange values of the service such as the park fee and maximum revenue. Therefore, the TCM can be interpreted here as the use of the demand curve to simulate the exchange values.

The last applied method, the consumer expenditure (CE) method showed the recreational value of the Park between US$8.74M and US$13.50M. The difference in the values depends on the expenses (basic stay or full stay as all inclusive) the visitors are willing to pay. The value is lower than CS and SEV, but higher than RR. This is expected as the method uses the travel costs survey data from ITCM, but does not go beyond to calculate the CS or simulate the entrance fee. In other words, the CE uses raw travel cost data from the survey. The travel cost data, in this case, represents exchange values.

Based on the statements above, Table 10 compares and reflects a summary of the methods used in our research for valuing recreational service in the UCNP.

Table 10.

Summary of the methods comparison.

| Methods | Uses the travel cost survey data | Consistent with SNA/ SEEA-EA exchange values | Value of the UCNP | Highlights of the method in current research |
|---|---|---|---|---|
| RR | No | Yes | Low | -excludes consumer surplus, the value is lower, the statistical data can be inaccurate/not full |
| ITCM (CS) | Yes | No | Very high | -the consumer surplus and cost of time is not compatible with SEEA-EA; requires information about the number of visitors |
| SEV | Yes | Yes | High | -experimental research; requires information about the number of visitors, dependent on TCM survey data |
| CE | Yes | Yes | Medium | - dependent on TCM survey data |

Some of our methods rely on expenditure data that are already recorded elsewhere in the SNA. Essentially, the RR approach identifies the gross value generated in the hospitality sector attributable to the Park. This gross value is recorded in national accounts as a part of value added (VA) of the hospitality sector, rather than a value generated by the Park that is added to the VA of the hospitality sector. After all, the latter would be a double counting. To avoid double counting, a shift between accounts should

be made. Thus, first identifying a sector under which the expenditure is originally accounted and then subtracting it from the value of the service.

An important aspect demanding careful attention is the uncertainty within ecosystem accounts (UN 2021, Venter et al. 2024). Uncertainty arises from several factors, not least data quality and availability. Ecosystem accounts require extensive, high-quality data, which are often hard to obtain. Although we encountered this challenge, our study did not focus deeply on data and method uncertainty. The confidence intervals estimated for the ITCM, SEV and CE approaches indicate considerable uncertainty within each estimate, but the difference between the approaches is substantially larger, which suggests that the choice of method remains a more important source of uncertainty than the standard error in the estimates themselves. Hence, further development of approaches to mitigate uncertainties and enhance the robustness of data in ecosystem accounts might be worthwhile, but clearly standardising the choice of method in SEEA guidelines seems even more important.

This study has some limitations. Due to the lack of available data, the research cannot confirm the number of park visitors per year. We also do not assess the impact of tourism on the ecological resources of the Park. To date, the number of visitors is modest compared to the size of the Park and the main attraction is the artificial lake in the middle of the Park that is used for watersports. The more ecologically sensitive areas, for example, the mountain slopes, have a much lower visitation rate, with many sites hardly visited at all. Hence, even though tourism in general may create a risk of undercutting the ecological assets that support its value to tourists, in this case, we assess this risk, at present, as still low.

Considering our research limitation, further research can focus on simulating the exchange values using the ITCM demand curve, but in the study area with available data of visitors number. Additionally, it would be interesting to reveal if the SEV can be applied for non-use cultural services.

## Conclusion

In this study, we compared four valuation methods for cultural ecosystem services in the part of the recreational value: resource rent (RR), travel cost method (TCM), simulated exchange value (SEV) and consumer expenditure (CE) method. The results showed that all four methods can be used for valuation; however, the difference in the resulting value is significant. The range of the recreational value varies between US$ 1.62M and US$ 65.19M annually. The RR calculations showed the lowest value amongst other methods, while being consistent with the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA-EA). The TCM with consumer surplus, on the contrary, showed the highest recreational value, while being incompatible with SEEA-EA. This was also to be expected, since the TCM with consumer surplus assesses a broader concept of value (SEEA - consistent valuation focuses on the producer surplus and excluded the consumer surplus). Two other methods, SEV and CE, provided results close to an

average value of other two methods, while staying aligned with the SEEA-EA concept. All methods, except RR, use the elements of travel cost. The CE method applies raw data from travel cost, while the SEV method goes further with demand curve simulation. The research confirmed the applicability of the demand curve from TCM to be used to simulate the exchange values. This means that TCM can be applied in three ways: (1) TCM with actual travel expenses as an indicator of the service value aligned with the SEEA EA, (2) TCM to construct a demand curve with an estimate of consumer surplus aligned with a welfare economics approach to valuation and (3) TCM to construct a demand curve to simulate exchange value.

We find that an RR method likely underestimates the 'true' value of the service when used for accounting since all expenses made to offer CS are deducted from the service's value, whereas with the expenditure-based method and the SEEA conforming with the TCM method, these costs are an expression of the value of the service. We also postulate that the SEV method seems to be best aligned with the valuation needs for cultural services and SEEA-EA, since it provides a market-conforming value in the case that such a market would exist, aligned with the valuation principles of the SNA.

We can state that different methods provide different results in recreational value. The selection of the method needs to depend on the purpose of the valuation. If the full welfare value of the recreational service in the Park needs to be shown, the TCM with consumer surplus is the appropriate choice. If a suitable entrance fee needs to be estimated for a public park, the SEV, based on the demand curve of TCM, can be helpful in the sense that it indicates which entrance fee generates maximum revenue; however, a park manager (e.g. a government) may not necessarily want to optimise revenue, but also consider other aspects, such as the need to educate children on the relevance of nature and, therefore, opt for a lower entrance fee. In other words, for many park management authorities, the purpose of the fee collection may not be to maximise the revenue, but to restore wildlife habitat, offer educational materials and services for visitors.

The RR and CE results are easier to connect to the GDP or SNA. However, our study shows that the RR may underestimate the economic contribution of a park from its tourism service and an SEV approach is preferred. Our paper again demonstrates that the choice of valuation method is critical since it can lead to quite different value outcomes and needs to be aligned with the purpose of the valuation. In the context of SEEA-EA, we recommend further application of SEV for valuing the tourism and recreation service of ecosystems.

While the study offers an analysis of various valuation methods, it is evident that each approach has its own limitations and drawbacks. Addressing these challenges would require improving data collection, accounting for non-market values and potentially combining multiple methods to achieve a more comprehensive valuation of cultural ecosystem services. The study does not solve the problem of how data uncertainty could impact valuation outcomes. Therefore, further research in this area is required.

## Acknowledgements

The authors would like to thank Ugam Chatkal State Nature National Park authorities, State Committee of Forestry of the Republic of Uzbekistan and Statistics Agency under the President of the Republic of Uzbekistan for providing support in this research. Special thanks to the editor and reviewers for their constructive feedback and suggestions, which improved the quality of this manuscript.

## Hosting institution

Environmental Sciences, Open Universiteit, PO Box 2960, 6401DL, Heerlen, the Netherlands.

## Ethics and security

Not applicable.

## Conflicts of interest

The authors have declared that no competing interests exist.

## References

- Ali MAS, Khan SU, Khan A, Khan AA, Zhao M (2020) Ranking of ecosystem services on the basis of willingness to pay: Monetary assessment of a subset of ecosystem services in the Heihe River basin. Science of The Total Environment 734 https://doi.org/10.1016/j.scitotenv.2020.139447
- Asafu-Adjaye J (2005) Environmental Economics for Non-Economists: : Techniques and policies for sustainable development (2nd ed.). World Scientific https://doi.org/10.1142/5727
- Badura T, Ferrini S, Agarwala M, Turner K (2017) Valuation for Natural Capital and Ecosystem Accounting. University of East Anglia. Norwich. Synthesis report for the European Commission. Centre for Social and Economic Research on the Global Environment. URL: https://ec.europa.eu/environment/nature/capital_accounting/pdf/Valuation_for_natural_capital_and_ecosystem_acounting.pdf
- Barton D, Obst C, Day B, Caparrós A, Dadvand P, Fenichel E, Havinga I, Hein L, McPhearson T, Randrup T, Zulian G (2019) Discussion paper 10: Recreation services from ecosystems. New York. Paper submitted to the Expert Meeting on Advancing the Measurement of Ecosystem Services for Ecosystem Accounting. URL: https://seea.un.org/sites/seea.un.org/files/discussion_paper_10_-_recreation_services_final_0.pdf
- Bekchanova M (2018) Mapping Cultural Ecosystem Services in Different Landscapes through the Perception of Tourists in Ugam Chatkal National Nature Park, Uzbekistan.

International Journal of Environment and Sustainability 7 (2). https://doi.org/10.24102/ijes.v7i2.908

- Bensitova G, Beshko N, Nuritdjanov D (2014) Ecological and economic characteristics Ugam-Chatkal National natural park. “Forest and Biodiversity Governance Including Environmental Monitoring” (FLERMONECA). Tashkent. Project report.
- Blaine T, Lichtkoppler F, Bader T, Hartman T, Lucente J (2015) An examination of sources of sensitivity of consumer surplus estimates in travel cost models. Journal of Environmental Management 151: 427-436. https://doi.org/10.1016/j.jenvman.2014.12.033
- Bockstael N, Freeman AM, Kopp R, Portney P, Smith VK (2000) On Measuring Economic Values for Nature. Environmental Science & Technology 34 (8): 1384-1389. https://doi.org/10.1021/es990673l
- Borzykowski N, Baranzini A, Maradan D (2017) A travel cost assessment of the demand for recreation in Swiss forests. Review of Agricultural, Food and Environmental Studies 98 (3): 149-171. https://doi.org/10.1007/s41130-017-0047-4
- Bowker JM, English DK, Donovan J (2015) Toward a Value for Guided Rafting on Southern Rivers. Journal of Agricultural and Applied Economics 28 (2): 423-432. https://doi.org/10.1017/s1074070800007410
- Boyle K (2017) Contingent Valuation in Practice. A Primer on Nonmarket Valuation83-131. https://doi.org/10.1007/978-94-007-7104-8_4
- Burkhard B, Maes J (2017) Mapping Ecosystem Services. Advanced Books https://doi.org/10.3897/ab.e12837
- Campos P, Caparrós A (2009) Can we use non-market valuation techniques in green national accounting applied to forests? Austrian Journal of Forestry 126: 53-76. URL: http://hdl.handle.net/10261/23541
- Campos P, Caparrós A, Oviedo J, Ovando P, Álvarez-Farizo B, Díaz-Balteiro L, Carranza J, Beguería S, Díaz M, Herruzo AC, Martínez-Peña F, Soliño M, Álvarez A, Martínez-Jauregui M, Pasalodos-Tato M, de Frutos P, Aldea J, Almazán E, Concepción E, Mesa B, Romero C, Serrano-Notivoli R, Fernández C, Torres-Porras J, Montero G (2019) Bridging the Gap Between National and Ecosystem Accounting Application in Andalusian Forests, Spain. Ecological Economics 157: 218-236. https://doi.org/10.1016/j.ecolecon.2018.11.017
- Caparrós A, Campos P, Montero G (2003) An Operative Framework for Total Hicksian Income Measurement: Application to a Multiple Use Forest. Environmental and Resource Economics 26 (2): 173-198. https://doi.org/10.1023/a:1026306832349
- Caparrós A, Oviedo J, Álvarez A, Campos P (2017) Simulated exchange values and ecosystem accounting: Theory and application to free access recreation. Ecological Economics 139: 140-149. https://doi.org/10.1016/j.ecolecon.2017.04.011
- Cheng X, Van Damme S, Li L, Uyttenhove P (2019) Evaluation of cultural ecosystem services: A review of methods. Ecosystem Services 37 https://doi.org/10.1016/j.ecoser.2019.100925
- Che SR (2022) Monetary valuation of biodiversity in the Dutch Part of the North Sea. RWS/WVL/BN REM..
- Clawson M (1959) Methods of measuring the demand for and value of outdoor recreation. Resources for the Future 10 (3). https://doi.org/10.1177/004728757201000331
- CMRU Resolution #1053 (2019) On rapid development of tourism in Tashkent region in 2019 – 2021. Cabinet of Ministers of the Republic of Uzbekistan (CMRU), in Uzbek language. URL: https://lex.uz/ru/docs/4673605

- CMRU Resolution #262 (2001) On the approval of the provisions on the Ugam-Chatkal state national nature park and Chatkal state biosphere reserve, of the charters of the Ahangaran and Burchmullo forestry enterprises. Cabinet of Ministers of the Republic of Uzbekistan (CMRU), Russian language. URL: https://lex.uz/ru/docs/419850
- CMRU Resolution #657 (2018) About improve of activities in the Ugam-chatkal State National Nature Park and including Burchmulla and Ahangaran State forestry. Cabinet of Ministers of the Republic of Uzbekistan (CMRU), in Uzbek language. URL: https://lex.uz/docs/3863834
- CMRU Resolution #913 (2017) On additional measures for the timely provision of fuel and energy resources. Cabinet of Ministers of the Republic of Uzbekistan (CMRU), in Russian language. URL: https://lex.uz/docs/3411089
- Daly E, Farley C (2010) Ecological economics: principles and applications. 2. Island Press. [In English]. [ISBN 1-55963-312-3]
- Dendoncker N, Keune H, Jacobs S, Gómez-Baggethun E (2013) Inclusive Ecosystem Services Valuation. Ecosystem Services3-12. https://doi.org/10.1016/b978-0-12-419964-4.00001-9
- EEA (2019) The European environment —state and outlook 2020. Knowledge for transition to a sustainable Europe. Luxembourg: Publications Office of the European Union. European Environment Agency (EEA). URL: https://www.eea.europa.eu/publications/soer-2020
- Ezebilo E (2016) Economic value of a non-market ecosystem service: an application of the travel cost method to nature recreation in Sweden. International Journal of Biodiversity Science, Ecosystem Services & Management1-14. https://doi.org/10.1080/21513732.2016.1202322
- Farrell C, Coleman L, Norton D, Kelly-Quinn M, Kinsella S, Obst C, Eigenraam M, O'Donoghue C, Sheehy I, Smith F, Stout J (2022) Applying ecosystem accounting to develop a risk register for peatlands and inform restoration targets at catchment scale: a case study from the European region. Restoration Ecology 30 (8). https://doi.org/10.1111/rec.13632
- Fauzi A (2006) Environmental and Natural Resource Economics: Theory and Applications. Jakarta: Publisher Scholastic Press..
- Garrod G, Willis K (1999) Economic valuation of the environment: Methods and case studies. 384. Cheltenham, UK: Edward Elgar. [In English]. [ISBN 1858986842]
- Graves P (2013) Environmental Valuation: The Travel Cost Method. Environmental Economics199-206. https://doi.org/10.1201/b15404-19
- Grilli G, Ferrini S, Luisetti T, Kerry Turner R (2021) The role of choice experiments in natural capital accounting approaches: fast track versus simulated exchange value in the Deben Estuary saltmarshes. Journal of Environmental Planning and Management 65 (7): 1281-1300. https://doi.org/10.1080/09640568.2021.1957794
- Haab T, McConnell K (2002) Valuing Environmental and Natural Resources. Cheltenham, U.K.: E. Elgar Pub. https://doi.org/10.4337/9781843765431
- Haines-Young R, Potschin-Young M (2018) Revision of the Common International Classification for Ecosystem Services (CICES V5.1): A Policy Brief. One Ecosystem 3 https://doi.org/10.3897/oneeco.3.e27108
- Hein L, Bagstad K, Obst C, Edens B, Schenau S, Castillo G, Soulard F, Brown C, Driver A, Bordt M, Steurer A, Harris R, Caparrós A (2020) Progress in natural capital accounting for ecosystems. Science 367 (6477): 514-515. https://doi.org/10.1126/science.aaz8901

- Horlings E, Schenau S, Hein L, Lof M, Jongh L, Polder M (2019) Experimental monetary valuation of ecosystem services and assets in the Netherlands. Statistics Netherlands and Wageningen University and Research. Report. URL: https://seea.un.org/sites/seea.un.org/files/cbs_wur_monetary_valuation_ecosystems_finalreport_august2019.pdf
- IPBES (2019) Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. Zenodo https://doi.org/10.5281/zenodo.5517154
- Kaszynska P, Coyle D, Dwyer E, Lawton R, Riganti P, Watson S, Damaso M, Wang Y (2022) Scoping Culture and Heritage Capital Report. URL: https://www.gov.uk/government/publications/scoping-culture-and-heritage-capital-report
- Lawton R, Fujiwara D, Hotopp U (2021) The value of digital archive film history: willingness to pay for film online heritage archival access. Journal of Cultural Economics 46 (1): 165-197. https://doi.org/10.1007/s10824-021-09414-7
- London Group on Environmental Accounting (LGEA) (2002) System of Environmental and Economic Accounts (SEEA 2000 – Draft for Statistical Commission 2002). URL: www4.statcan.ca/citygrp/london/publicrev/pubrev.htm
- Masiero M, Pettenella D, Boscolo M, Barua SK, Animon I, Matta JR (2019) Valuing Forest Ecosystem Services. Forestry Working Paper, No. 11. Rome, FAO, 216 pp. https://doi.org/10.18356/71455796-en
- Menendez-Carbo S, Ruano MA, Zambrano-Monserrate M (2020) The economic value of Malecón 2000 in Guayaquil, Ecuador: An application of the travel cost method. Tourism Management Perspectives 36 https://doi.org/10.1016/j.tmp.2020.100727
- National Research Council (2005) Valuing Ecosystem Services: Toward Better Environmental Decision-Making. Washington, DC: The National Academies Press, 290 pp. [ISBN ISBN 978-0-309-09318-7] https://doi.org/10.17226/11139
- NCAVES, MAIA (2022) Monetary valuation of ecosystem services and ecosystem assets for ecosystem accounting: Interim Version 1st edition. United Nations Department of Economic and Social Affairs, Statistics Division, New York.. URL: https://seea.un.org/file/21684/download?token=PQomzG6W
- O'Brien L, Morris J (2010) Estimating visitor and visit numbers to woodlands. The Research Agency of the Forestry Commission.. URL: https://cdn.forestresearch.gov.uk/2022/02/estimating_visitor_and_visits_report_2010.pdf
- Obst C, Hein L, Edens B (2015) National Accounting and the Valuation of Ecosystem Assets and Their Services. Environmental and Resource Economics 64 (1): 1-23. https://doi.org/10.1007/s10640-015-9921-1
- Obst C (2018) The valuation of ecosystem services and assets for SEEA ecosystem accounting.
  Background paper on SEEA EEA approach to valuation prepared for the BfN/UNSD workshop on ecosystem valuation: Bonn, Germany – April 2018. URL: https://seea.un.org/sites/seea.un.org/files/documents/Valuation_Bonn/ecosystemaccountingvaluationprinciples_bonnworkshop.pdf
- Oviedo JL, Campos P, Caparrós A (2010) Simulated Exchange Value Method: Applying Green National Accounting to Forest Public Recreation. Instituto de Políticas y Bienes Públicos (IPP), CSIC.. Working Papers 1016.
- Parsons G (2003) The Travel Cost Model. A Primer on Nonmarket Valuation269-329. https://doi.org/10.1007/978-94-007-0826-6_9

- Pelletier M, Heagney E, Kovač M (2021) Valuing recreational services: A review of methods with application to New South Wales National Parks. Ecosystem Services 50 https://doi.org/10.1016/j.ecoser.2021.101315
- Perman R, Ma Y, Common M, Maddison D, Mcgilvray J (2011) Natural resource and environmental economics. 4th ed. Pearson Addison Wesley, 744 pp. [In English]. [ISBN 0321417534]
- Remme R, Edens B, Schröter M, Hein L (2015) Monetary accounting of ecosystem services: A test case for Limburg province, the Netherlands. Ecological Economics 112: 116-128. https://doi.org/10.1016/j.ecolecon.2015.02.015
- Ricardo Energy & Environment (REE) (2016) Reviewing cultural services valuation methodology for inclusion in aggregate UK natural capital estimates. Report for Office National Statistics. November 2016..
- Richardson L, Loomis J, Kroeger T, Casey F (2015) The role of benefit transfer in ecosystem service valuation. Ecological Economics 115: 51-58. https://doi.org/10.1016/j.ecolecon.2014.02.018
- Ridding L, Redhead J, Oliver T, Schmucki R, McGinlay J, Graves A, Morris J, Bradbury R, King H, Bullock J (2018) The importance of landscape characteristics for the delivery of cultural ecosystem services. Journal of Environmental Management 206: 1145-1154. https://doi.org/10.1016/j.jenvman.2017.11.066
- Rosenthal D, Loomis J, Peterson G (1984) The travel cost model [microform]: concepts and applications. Fort Collins, Colo. : U.S. Dept. of Agriculture, Forest Service.
- Ruiz-Frau A, Hinz H, Edwards-Jones G, Kaiser MJ (2013) Spatially explicit economic assessment of cultural ecosystem services: Non-extractive recreational uses of the coastal environment related to marine biodiversity. Marine Policy 38: 90-98. https://doi.org/10.1016/j.marpol.2012.05.023
- Sagger H, Philips J, Haque M (2021) Valuing Culture and Heritage Capital: A framework towards informing decision making. Department for Digital, Culture, Media & Sport, UK.. URL: https://assets.publishing.service.gov.uk/media/600b02c78fa8f5655299d204/GOV.UK_-_Framework_Accessible_v2.pdf
- Sannigrahi S, Chakraborti S, Joshi PK, Keesstra S, Sen S, Paul SK, Kreuter U, Sutton P, Jha S, Dang KB (2019) Ecosystem service value assessment of a natural reserve region for strengthening protection and conservation. Journal of Environmental Management 244: 208-227. https://doi.org/10.1016/j.jenvman.2019.04.095
- Scheufele G, Pascoe S (2023) Ecosystem accounting: Reconciling consumer surplus and exchange values for free-access recreation. Ecological Economics 212 https://doi.org/10.1016/j.ecolecon.2023.107905
- Smith VK, Kopp R (1980) The Spatial Limits of the Travel Cost Recreational Demand Model. Land Economics 56 (1). https://doi.org/10.2307/3145830
- Smith VK, Desvousges W, McGivney M (1983) The Opportunity Cost of Travel Time in Recreation Demand Models. Land Economics 59 (3). https://doi.org/10.2307/3145728
- Smith VK, Kaoru Y (1987) The Hedonic Travel Cost Model: A View from the Trenches. Land Economics 63 (2). https://doi.org/10.2307/3146579
- Sohngen B, Lichtkoppler F, Bielen M (2000) The Value of Day Trips to Lake Erie Beaches. Dept. of Agricultural, Environmental, and Development Economics, Ohio State University.. URL: https://repository.library.noaa.gov/view/noaa/42903
- TEEB (2010) The economics of ecosystems and biodiversity: mainstreaming the economics of nature: A synthesis of the approach, conclusions and recommendations of

TEEB. United Nations Environment Programme. URL: https://wedocs.unep.org/20.500.11822/7851

- Tobarra-González MÁ, Mendoza-Monpeán J (2018) Recreational value of El Valle and Carrascoy Natural Park. Anatolia 30 (2): 214-222. https://doi.org/10.1080/13032917.2018.1519196
- Todjibaev K, Kadirov R, Saromsakov E (2008) Biodiversity of the Ugam-Chatkal National Park. Tashkent, Gazalkent. Digest.
- Trice A, Wood S (1958) Measurement of Recreation Benefits. Land Economics 34 (3). https://doi.org/10.2307/3144390
- Tsoy V, Ashirov S (2008) Western Tien Shan: A Journey to the Origins. Talqin. Tashkent. [In Russian].
- UN (1953) A System of National Accounts and Supporting Tables. New York, United Nations (UN). Studies in Methods, Series F. No. 2. URL: https://unstats.un.org/unsd/nationalaccount/docs/1953sna.pdf
- UN, European Union, Food and Agriculture Organization, Organisation for Economic Co-operation and Development, World Bank Group (2014) System of Environmental Economic Accounting 2012:Experimental Ecosystem Accounting. New York: United Nations (UN) https://doi.org/10.1787/9789210562850-en
- UN (2020) Minutes of the Extraordinary Meeting of the United Nations Committee of Experts on Environmental-Economic Accounting. United Nations (UN). Area B2: SEEA Ecosystem Accounting (Methodological Development for Normative Standards and other Research). URL: https://seea.un.org/sites/seea.un.org/files/minutes_extraordinary_v5_clean.pdf
- UN, et al. (2021) System of Environmental-Economic Accounting— Ecosystem Accounting. United Nations (UN). White cover (pre-edited) version. URL: https://seea.un.org/sites/seea.un.org/files/documents/EA/seea_ea_white_cover_final.pdf
- UNDP (2015) Fifth national report of the Republic of Uzbekistan on conservation of biodiversity. Tashkent, Uzbekistan. United Nations Development Programme (UNDP). URL: https://www.cbd.int/doc/world/uz/uz-nr-05-en.pdf
- UNESCO (2016) Report of the Decisions adopted during the 40th session of the World Heritage Committee. United Nations Educational, Scientific and Cultural Organization (UNESCO), Istanbul, Turkey. WHC/16/40.COM/19.
- UNSD (2017) Technical Recommendations in support of the System of Environmental-Economic Accounting 2012 – Experimental Ecosystem Accounting. UN, New York. White cover, United Nations Statistics Division. URL: https://seea.un.org/sites/seea.un.org/files/technical_recommendations_in_support_of_the_seea_eea_final_white_cover.pdf
- Vallecillo S, La Notte A, Zulian G, Ferrini S, Maes J (2019) Ecosystem services accounts: Valuing the actual flow of nature-based recreation from ecosystems to people. Ecological Modelling 392: 196-211. https://doi.org/10.1016/j.ecolmodel.2018.09.023
- Venter Z, Czúcz B, Stange E, Nowell M, Simensen T, Immerzeel B, Barton D (2024) 'Uncertainty audit' for ecosystem accounting: Satellite-based ecosystem extent is biased without design-based area estimation and accuracy assessment. Ecosystem Services 66 https://doi.org/10.1016/j.ecoser.2024.101599
- Ward F, Beal D (2000) Valuing Nature with Travel Cost Models. Cheltenham, UK: Edward Elgar, Cheltenham, UK. https://doi.org/10.4337/9781840647778
- Zandi S, Limaei SM, Amiri N (2018) An economic evaluation of a forest park using the individual travel cost method (a case study of Ghaleh Rudkhan forest park in northern

Iran). Environmental & Socio-economic Studies 6 (2): 48-55. https://doi.org/10.2478/environ-2018-0014

- Zhang F, Wang XH, Nunes PL, Ma C (2015) The recreational value of gold coast beaches, Australia: An application of the travel cost method. Ecosystem Services 11: 106-114. https://doi.org/10.1016/j.ecoser.2014.09.001

## Supplementary materials

### Suppl. material 1: Descriptive statistics for independent variables doi

**Authors:** Bronzes A.
**Data type:** Excel file - descriptive statistics
**Brief description:** Descriptive statistics for independent variables, obtained from the survey of Ugam Chatkal State Nature National Park visitors. The data were used for ITCM analysis.
Download file (12.07 kb)

### Suppl. material 2: ITCM results based on the annual park visits doi

**Authors:** Bronzes A.
**Data type:** Excel file - calculating the total CS
**Brief description:** Results of ITCM, based on the annual park visits estimation.
Download file (11.13 kb)

### Suppl. material 3: SEV results based on the annual park visits doi

**Authors:** Bronzes A.
**Data type:** Excel file - SEV calculations
**Brief description:** Calculation of SEV results, based on the estimation of the annual park visits.
Download file (11.56 kb)

### Suppl. material 4: Consumer expenditure results based on annual park visits doi

**Authors:** Bronzes A.
**Data type:** Excel file - calculations of total consumer expenditure
**Brief description:** Results of total consumer expenditure, based on the annual park visits estimation.
Download file (11.67 kb)

## Endnotes

*1 the proportion of the park's territory in three districts (in %)

*2 http://www.cbu.uz/en/statistics/dks/2018/02/106922/

*3 The minimum age for employment or work in Uzbekistan is 15 years and, in certain cases, it is 14 years. Amongst the respondents, there were individuals aged 16 who reached the Park using taxi or public transport. They are included in the research.