Chapter 7
Economic Valuation of Ecosystem Services

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7.1 Introduction

An ecosystem is defined as the recycling of nutrient streams along paths that consist of living subsystems, connecting living and nonliving subsystems (Shaw & Allen, 2018). In other words, an ecosystem is a complex and dynamic combination of all plant communities, animals, and living microorganisms and interactions with components and the environment (Cowan, 2007). Ecosystems provide several goods (e.g., food production) and services (e.g., air regulation) to humans and contribute to their well-being and survival (Englund et al., 2017). These services are called ecosystem services (ESs). ESs or the benefits that people receive from ecosystems (MEA, 2005) refer to the services and products provided by an ecosystem under appropriate ecological conditions (Xie et al., 2021). The concept of ES introduces the idea that human societies are closely dependent on natural ecosystems and the organisms that host them (Barot et al., 2017). So, these services are essential for human livelihood, well-being, and health (Balasubramania, 2020; Li et al., 2020; Sannigrahi et al., 2021). According to the importance of ES in human life, the capacity to provide ecosystem services has changed significantly due to changes in human activities and the natural environment, and as a result, the supply of ES cannot sate the demand (Han et al., 2022). Many studies show decrease in ES in wetlands, forests, grasslands, and natural habitats (Zarandian et al., 2017; Xie et al., 2018; González-García et al., 2020; Chen et al., 2021; Rötzer et al., 2021; Xu et al., 2021; Sheng et al., 2022); ignoring the value of ES in these ecosystems can reduce the protection of these ecosystems (Sarkheil et al., 2021). The loss of ES has prompted many prominent researchers and organizations around the world to come up with new proposals to re-evaluate the relationship between community and ESs (Costanza et al., 2014). One of the mechanisms that can be used to anew this relationship is to determine the economic values (Perez-Verdin et al., 2016). Economic valuation, in addition to facilitating the decision-making process, provides essential information for the better management of ecosystems and their suitable consumption (Badamfirooz et al., 2021). Accordingly, in order to better understand the value of ES, it is necessary to quantify them and then economically evaluate nonmarket resources in order to identify all the resources available in a community. Although the economic valuation of ES is one of the main tools of environmental protection (Balasubramania, 2020), but the application of these methods in real policy is still a rare phenomenon (Merriman & Murata, 2016).

In this regard, the aim of this study is to review the concepts of economic valuation of ES as an important tool to increase attention to ES in environmental decisions and planning.

7.2 Theoretical Foundations

7.2.1 The Importance of ES for the Economic and Social Well-Being of the People

Ecosystems, with the goods and services they provide, underlie all aspects of human, cultural, social, and economic well-being (Wood et al., 2018). Unfortunately, currently, ecosystems around the world are being destroyed by the pressure of human intervention, which has serious consequences for nature's ability to provide ecosystem goods and services (EGS) (MEA, 2005). The main reason for the decline of many EGS is to ignore their value and importance (Wittmer & Gundimeda, 2012). Meanwhile, given that changes in biological or physical parameters are more meaningful to humans, ESs were used to link ecological or biophysical changes to economic and social consequences (Sharon et al., 2018). In this regard, given the importance of ES, many efforts have been made to identify methods in which ecosystems are useful to humans and the feedback between management actions and their impact on ES (Wood et al., 2018). Ecosystem goods are products or outputs of nature that are extracted and consumed by people. Also, ES including conditions, processes, and functions of natural ecosystems and related species that provide sustainability and the needs of human life (De Groot et al., 2002). These services are vital inputs for the production of economic goods that are necessary for the sustainability of life support systems and create a wide range of nonmarket benefits and very high economic value (Heal, 2000).

Generally, the role of ecosystem services in the economic and social welfare of people is due to the following two main reasons:

- Natural resources are inputs for the production of goods.
- They lead to the preservation of natural assets (an asset is defined as something that has value or benefits, and natural assets also refer to the inventory of natural resources such as pastures, forests, Water assets, and geological), which is done for two reasons: first, by reviving and reproducing the capacities of natural assets and second, by absorbing by-products from the production process.

7.3 Classification of ES

Many concepts of ES have led to the emergence of various related classifications. Classification systems are hierarchical approaches to organizing information so that data can be easily comparable (US Bureau of Labor Statistics, 2019). These systems also have a flexible thesaurus, vocabulary, and structure that balance stability with the needs of new research (Finisdore et al., 2020). The most important of these classifications are described by Costanza et al. (1997) in the *System of Environmental-Economic Accounting Central Framework* (SEEA, 2003), Millennium Ecosystem

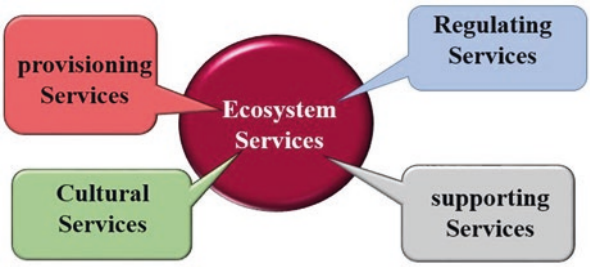

Fig. 7.1 The types of ES

Assessment (MEA) (Boyd & Banzhaf, 2007; Costanza, 2008; Daily et al., 2009; De Groot et al., 2010), the Economics of Ecosystems and Biodiversity (TEEB, 2010) (Staub et al., 2011), and the Common International Classification of ES (CICES, 2013) (FEGS-CS, 2013; NESCS, 2015). The variety of classification methods suggests that depending on the objectives and understanding of the observer, there are many ways to classify ES. However, from a system's point of view, the selected set of services should include a comprehensive analysis. Currently, most classifications are based on MEA ideas (Sumarga et al., 2015; Tekken et al., 2017; Carrilho & de Almeida Sinisgalli, 2018). The advantage of defining and classifying MEA is its simplicity. According to the MEA, these services include four categories (Fig. 7.1).

The MEA simply defined these services:

- Provisioning: Goods taken from ecosystems
- Regulating: Benefits of regulating ecosystem processes
- Cultural: Nonmaterial benefits of ecosystems
- Supporting services required to produce other ESs

The first three services directly affect humans, and the fourth service is critical to the continued provision of other services by ecosystems (MEA, 2005). The types of ES based on the MEA are shown in Table 7.1.

7.4 Economic Valuation of Ecosystem Services (ESV)

Monetary arguments for recognizing the relative importance of different forms of ESs and natural capital may not be universally accepted, but it can be useful and convincing for decision-makers. In other words, if the benefits provided by nature are not valued, they are considered "worthless," and the current trend of decay and destruction of natural systems would be continued (Mohammadyari & Zarandian, 2022). According to this issue, the use of economic valuation has many benefits to highlight the significance of ecosystems (Costanza et al., 2014). Evaluating ES is a tool to express the relative importance of the benefits that ecosystems provide to people. ESV was first used in the early 1990s (Liu et al., 2010), and it was approved at the Conference (COP) in Nagoya in 2010. In this report, the value of economic evaluation is mentioned as a key tool to better understand the mainstream of

Table 7.1 ES classification

Category	Subcategory	Example/definition
Provisioning services	Genetic resources	Genes used to increase crop resistance
	Raw materials	Fiber (timber, wood, fertilizer, and fodder)
	Biochemicals	Ginseng, garlic, and plant extracts for pest control
	Ornamental resources	Decorative plants and artisan work
	Freshwater	Groundwater, rainwater, and surface water
	Food	Products (cereals, vegetable, and fruits)
		Livestock (chicken, cattle, and other livestock)
		All kinds of fish and shrimp
		Wild foods (mushrooms, fruits, and nuts)
Regulating services	Climate regulation	The effects that ecosystems have on the global climate through the removal of greenhouse gases or aerosols
	Air quality regulation	The effects that ecosystems have on air quality by emitting chemicals into the atmosphere (as a source) or by removing them from the Earth's atmosphere (as a sink)
	Water regulation	The effect of ecosystems on the timing and the number of watercourses, floods, and watershed recharging, especially in terms of water storage potential in the landscape
	Erosion control	The role that vegetation plays in soil stabilization
	Regulation of diseases	The role of ecosystems in the prevalence or abundance of human pathogens
	Pollination	Forest bees help pollinate plants
	Organizing natural disasters	Capacity of ecosystems in reducing disasters caused by natural disasters such as storms and tsunamis
Cultural services	Ethical values	Inspirational, religious, aesthetic, and intrinsic values
	Existential values	Belief that all species, regardless of their usefulness for humans, have protective value
	Recreation and ecotourism	Walking and cycling
Supporting services	Nutrient cycle	Processes by which nutrients such as phosphorus, sulfur, and nitrogen are extracted from mineral, aquatic, and atmospheric sources, or eventually returned to the atmosphere, soil, and water as a cycle of living organisms
	Soil formation	The process of decomposition of organic matter to form soil
	Photosynthesis	Production of living materials through the absorption and accumulation of energy by living organisms
	Water cycle	Flow of water through ecosystems in solid, liquid, and gas forms

biodiversity. Subsequently, ESV studies increased rapidly. In classical economics, the share of nature services is related to the value of their use (Häyhä & Franzese, 2014). While neoclassical welfare economics defines the economic value of goods or services as a measure of well-being (in monetary units) after production and consumption (Burkhard & Maes, 2017). Thus, according to the definition of neoclassical economics, economic value arises from the mental preferences of individuals (Häyhä & Franzese, 2014). Acceptance of individuals to compensate for the loss of an environmental benefit or increase of an environmental loss is called willingness to pay (WTP) or willingness to accept (WTA) (Mohammadyari et al., 2019). Monetary valuation of ecosystems provides valuable information about social benefits and costs to policymakers and environmental managers. So the estimation of monetary value for ESs has become a tool to increase the importance of these services in the decision-making process (Schild et al., 2018). ESV, in addition to increasing the motivation to protect the ecosystem in the public and private sectors, also helps reduce poverty in developing countries (Christie et al., 2012). In fact, economic assessment helps to manage ecosystem-based management, and tools are important for supporting ecosystem management. For this purpose, market price or quasi-market price is used to estimate the social and economic benefits of ES (Folkersen, 2018). Using a nonmarket approach is for goods such as water quality and the like for which there is no specific market. In a real market, the economic value of goods or services is determined by their supply and demand. Supply of goods or services refers to the cost of production for producers in order to provide a good or service. On the other hand, the benefit or welfare that consumers gain from a good or service is called demand (Burkhard & Maes, 2017). Many studies have examined ESV (O'garra, 2012; Vo et al., 2012; Martín-López et al., 2014; Cuni-Sanchez et al., 2016; Jiang et al., 2017; Rewitzer et al., 2017), and a review of the ESV literature emphasizes that the need for ES is not only due to the direct goods and services they offer, but also noncommercial services such as recreational and aesthetic aspects play an important role in human mental and physical health, and this indicates the high value of nonmarket services of natural resources in comparison with their goods and market services (Morsali et al., 2020). ESV can serve a number of purposes, including the following:

- Communicating the value of ES by highlighting their economic contributions to societal goals.
- Comparing the cost-effectiveness of an investment.
- Evaluating the impacts of development policies. This could include evaluating the ES costs associated with habitat conversion, runoff, or pollutant discharge. It could also include looking at the benefits of increased investment in enforcing environmental regulation and in strengthening resource management.
- Building markets for ES.

Natural resource economists have considered the economic welfare benefits of nature for decades. They use a framework of total economic value to reflect the multiple different types of values that ecosystems can provide (Fig. 7.2). This framework includes both use and nonuse values that individuals and communities

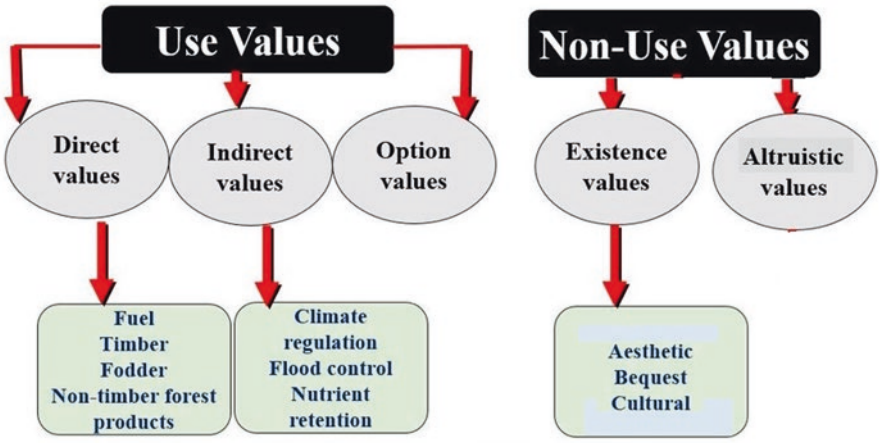

Fig. 7.2 Total economic value

gain or lose from marginal changes in ES. Use values arise from consumption, while nonuse values require the use or consumption of the ES. Use values can easily be measured by market prices or other tools and involved in decision-making processes. There is a good consensus among environmental economists that in addition to use values, natural resources may have values that are unrelated to actual direct or indirect use. These values, known as nonuse values, do not involve any observable behavior and are only the result of a simple mental experience. Therefore, nonuse values can be observed in market purchases or based on functions, nonconsumption, or intrinsic values in goods can be deduced inseparably (Mohammadyari & Zarandian, 2022).

As shown in Fig. 7.2, use values are divided into the following three categories:

- *Direct-use value:* The value of all goods and services resulting from the direct or planned use of ecosystems, the consumption of resources (such as fodder and food), or the nonconsumption of services (such as regulation). They usually include production services.
- *Indirect-use value:* These categories include regulating and support services and are derived from the performance of ecosystems underlying direct-use activities.
- *Option value:* The value that a person places on having the authority to use a service or resource directly or indirectly in the future, even if it is not currently used.

Nonuse value or passive value refers to the knowledge of ecosystem conservation and includes all services (such as provisioning, regulating, cultural, and supporting). In fact, this value does not include the actual use of ecosystem goods and services. According to Fig. 7.2, nonvalue uses fall into four main categories:

- *Existence value:* A value that depends on knowledge about the existence of species and ES is called existential value. Some studies consider the bequest value as part of existence value, while others place it in a separate category. The value

of bequest refers to the value that human beings place on the availability of goods and services for the future.

- *Altruistic value:* The value that people place on the availability of ecosystem resources or services to others in the current generation is called altruistic value.

In order to evaluate ES, three basic approaches are considered by total economic value (TEV).

1. In market transactions that are directly related to ES, values are obtained.
2. In parallel market transactions that are indirectly related to the intended ES, values are extracted.
3. Using the creation of hypothetical markets, ES value information is evaluated (Croci et al., 2021).

7.5 ES Economic Valuation Methods

Economic valuation of all the benefits that humans derive from ecosystems is practically impossible. Because ecosystems have spiritual, religious, and historical values, for most people the valuation of these values in utilitarian ways is not fully understood. Accordingly, public opinion is questioned for the value of such services. Given that almost 80% of ES are not traded in the markets, in this regard, the estimation of their economic value depends on different methods of economic valuation (Carrilho & de Almeida Sinisgalli, 2018). Therefore, ESV methods have always been considered by experts as a central issue in environmental economics and natural resources and have also been criticized by a wide range of environmentalists and natural resources advocates alike. Failure to properly calculate the value of some environmental resources has consequences that have negative effects on the environment, ecosystem, and society. ESV includes a wide range of methods that can be implemented in a variety of ways and in combination with other techniques. Several methods have been proposed for the economic valuation of ecosystem goods and services. The design of these methods has been based on understanding the complexity of the natural environment using economic analysis (Burkhard & Maes, 2017). Market price, contingent valuation (CV), choice experiment (CE), travel cost (TC), benefit transfer (BT), contingent behavior (CB), replacement cost (RC), damage cost, net present value, and hedonic pricing (HP) are the most important methods. At present, the efficiency of these methods is well-established and confirmed. The choice of valuation methods depends on many factors such as the type of service, the purpose of the study, the time, and the availability of resources (Dang et al., 2021). Table 7.2 presents a fairly comprehensive overview of the methods used by researchers all over the world for a variety of ES.

According to the literature (Table 7.2), most of the methods that researchers have chosen to study ESV are CV and market price methods, respectively. According to the classification of monetary valuation methodology, the CV is in the category of

Table 7.2 A review of studies on the economic valuation of ecosystem services

Category	Valuation method							Subject	References
	CV	CE	TC	BT	CV and TC	Market price	CB		
Provisioning services	*							Wood	Groot et al. (2002)
	*							Mining Ecosystem restoration	Beltrán Morales et al. (2005)
	*							Drinking water	Avilés-Polanco et al. (2010)
						*		Food	O'garra (2012)
		*						Food	Camarena et al. (2012)
	*							Drinking water	Almendarez-Hernandez et al. (2013)
	*							Drinking water	González-Davila (2013)
						*		Food	Martín-López et al. (2014)
						*		Food and fiber and fresh water	Považan et al. (2015)
	*							Irrigation water	Vélez-Rodríguez et al. (2015)
	*							Food	Romano et al. (2016)
	*							Drinking water	Peng and Oleson (2017)
	*							Food	Torres-Miralles et al. (2017)
						*		Food and fiber and fresh water	Schirpke et al. (2017)
						*		Food	Carrilhoand de Almeida Sinisgalli (2018)
						*		Food and fiber	Marta-Pedroso et al. (2018)
	*							Drinking water	Mohammadyari et al. (2018)
						*		Food and fiber	Ramel (2020)

(continued)

Table 7.2 (continued)

Category	Valuation method							Subject	References
	CV	CE	TC	BT	CV and TC	Market price	CB		
Regulating services	*							Clean air, water conservation	Larqué-Saavedra et al. (2004)
	*							Watershed protection	López Paniagua et al. (2007)
	*							River restoration	Ojeda et al. (2008)
	*							Watershed protection	Silva-Flores et al. (2010)
	*							Watershed protection	del Ángel Pérez et al. (2011)
	*							Watershed protection	Sánchez Brito et al. (2012)
		*						Carbon sequestration	Balderas Torres et al. (2013)
	*							River restoration	Jaramillo-Villanueva et al. (2013)
		*						Coastal wetlands	Camacho-Valdez et al. (2013)
								River drainage	HE et al. (2015)
				*				Climate and erosion and water	Považan et al. (2015)
	*							Water shortage	Bozorg-Haddad et al. (2016)
	*							Air and erosion and water	Torres-Miralles et al. (2017)
						*		Climate	Schirpke et al. (2017)
				*				Cyclones	Vink and Ahsan (2018)
				*				Climate and erosion	Marta-Pedroso et al. (2018)
	*							Polluted urban lake	Sebo et al. (2019)
						*		Climate	Ramel (2020)

Cultural services	*							Marine resources	
		*						Marine recreation	Wielgus et al. (2009)
							*	Tourism	Kragt et al. (2009)
	*							Coral reef protection	
							*	Tourism	Prayaga et al. (2010)
	*							Recreational	Moradi et al. (2011)
	*							Urban trees	Lo and Jim (2015)
			*			*		Recreation and ecotourism	Považan et al. (2015)
					*			Lake	Jala and Nandagiri (2015)
	*					*		Recreation and ecotourism	Gandarillas et al. (2016)
	*							Natural area	Almendarez-Hernández et al. (2016)
	*							Historic sites	Kuhfuss et al. (2016)
	*							Coral reef management	Trujillo et al. (2016)
				*	*			Recreation and ecotourism	Ninan and Kontoleon (2016)
	*							Forest park	Mohammadi Limaei et al. (2016)
		*						Agricultural heritage and aesthetics	Rewitzer et al. (2017)
	*							Recreation and ecotourism and aesthetic	Torres-Miralles et al. (2017)
			*					Recreation and ecotourism	Schirpke et al. (2017)
			*					Geopark	Pourbalighy and Hejazi (2018)
		*						Recreation and ecotourism	
	*							Spiritual and religious	
			*					Local entertainment	Kipperberg et al. (2019)
				*		*		Recreation and ecotourism	Ramel (2020)
			*					Recreational wetland	Morsali et al. (2020)
	*							Tourism and aesthetic	Amirnejad et al. (2020)
						*		Aesthetic	Hatan et al. (2021)

(continued)

Table 7.2 (continued)

Category	Valuation method							Subject	References
	CV	CE	TC	BT	CV and TC	Market price	CB		
Supporting services	*							Biodiversity	Bräuer (2003)
		*						Biodiversity	Juutinen et al. (2011)
	*							Biodiversity	Kamri (2013)
				*				Biodiversity	Gandarillas et al. (2016)
	*							Biodiversity	Ninan and Kontoleon (2016)
	*							Biodiversity	Parsons and Myers (2017)
	*							Biodiversity	Torres-Miralles et al. (2017)
	*							Biodiversity	Ferreira et al. (2017)
	*							Biodiversity	Marta-Pedroso et al. (2018)
	*							Biodiversity	Molina et al. (2019)

Various services		*						Wetland	Birol et al. (2006)
	*							Forest	Tao et al. (2012)
	*							National park	Kamri (2013)
					*			Lake	Jala and Nandagiri (2015)
		*						Forest	Balderas-Torres et al. (2015)
					*			Cultivated land	Huang and Wang (2015) and Považan et al. (2015)
	*							Green space	Song et al. (2015)
	*							Wetland	Siew et al. (2015)
	*							Urban park	Latinopoulos et al. (2016)
	*							Coastal promenade	Lee and Yoo (2016)
	*							Beaches	Peng et al. (2017)
		*						Natural functions of lake	Vakili Ghaserian et al. (2017)
			*					Areas of high natural value	Gawrońska et al. (2018)
				*				Beaches	Mehvar et al. (2018)
			*					Parks and protected areas	Jaung and Carrasco (2020)
	*							Provisioning and regulating in forests	Naime et al. (2020)
					*			Forest	Tahami Pour Zarandi and Bitars (2020)
				*				Wetlands	Badamfirooz et al. (2021)
	*							Coastal lagoon	
		*						Lake	
	*							Urban park	Silva et al. (2022)

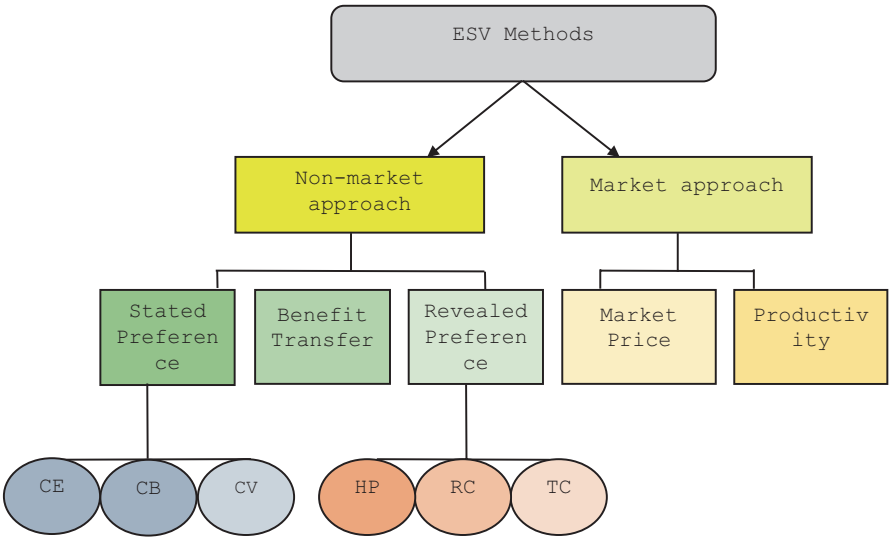

Fig. 7.3 Schematic view of ESV methods

nonmarket valuation, and the market price method is in the category of direct market valuation. In nonmarket valuation methods, the value of services and goods is formed through obvious preferred methods or hypothetical markets. In fact, in these methods, services and goods are not valued directly at market prices (Folkersen, 2018). In addition to the conditional valuation method, CB and CE methods are also in the category of nonmarket methods. Flexibility is the most important advantage of the CV method that is useful for all market and nonmarket goods and includes the types of benefits that humans derive from ecosystems, such as nonconsumption values and option values. However, the sensitivity of this method to conducting a survey is one of the disadvantages of this method, which limits the generalization of results. On the other hand, relatively easy and straight implementation is the strength of the market price method, but the main bug of this method is that if the market is distorted, prices do not show the true value of the service, which makes economic values biased (Naime et al., 2020). Figure 7.3 presents the methods of economic valuation of ecosystem goods and services.

The following are definitions of ESV methods.

7.5.1 Market Approach

Market-based methods fall into two categories, which are market prices and productivity methods.

7.5.1.1 Productivity Method

Using this method, the economic value of the benefits of the ecosystem used in the production chain for the commercial goods sold can be estimated economically. In this case, natural resources are considered part of production, so any change in their quality or quantity affects production costs and ultimately the price of the product (Badamfirooz et al., 2021).

7.5.1.2 Market Price Methods

In market price methods, the direct costs observed from the real markets related to their presentation as indicators are used to evaluate services or goods (Croci et al., 2021). In fact, this method is used to estimate the economic value of ecosystem goods traded in commercial markets. In this method, based on changes in a final product or service, the total economic surplus (producer and consumer) is estimated (Badamfirooz et al., 2021).

7.5.2 Nonmarket Approach

Nonmarket ecosystem services (such as aesthetics and tourism) are positive externalities that, if valued monetarily, can easily be used in economic decisions (Burkhard & Maes, 2017). Nonmarket methods include three categories: revealed preference, benefit transfer method, and stated preference method.

7.5.2.1 Revealed Preference

Revealed preference methods analyze the relationship between demands for certain market goods and the preferences of related nonmarket goods and services (Tinch et al., 2019). These methods are defined based on conventional and proxy markets and allow economists to use the actual choices of individuals in relevant markets to determine the value of environmental services. Thus, the value of nonmarket resources and public goods is obtained by using the consumption behavior of individuals in related markets (Mohammadyari & Zarandian, 2022). TC methods, RC methods, and HP are among the methods that fall into this category.

- TC Method

The TC method is estimated based on the time and cost of travel of people visiting a place, and the basic premise is that the costs for a person that incurs to visit a place of entertainment reflect the value of the person for that place. In this method, it is assumed that the value of the place or its recreational services reflects the willingness of people to pay to use that place. Zonal travel cost method (ZTCM), single and

multiple site models, random utility approach, and individual travel cost method (ITCM) are different types of this method (Mohammadyari & Zarandian, 2022). Among these methods, two methods include ITCM and ZTCM are mostly used in the economic valuation of ES.

ITCM method: This method is based on a survey in which a questionnaire is asked for visitors in a place, questions about accommodation, number of visits and trips, expenses, etc. In the ITCM method, the costs that are spent on the consumption of facilities and recreational facilities of a particular place are presented as a symbol of price. These costs include travel expenses, entrance fees, location costs, and the amount spent on capital equipment (Flemming & Cook, 2008). This method is a suitable tool for economic evaluation of ES for the following reasons:

- This method is relatively inexpensive.
- It follows the conventional empirical methods used by economists to estimate economic values based on market prices.
- This method is based on the actual behavior of what people are actually doing, rather than their willingness to pay.
- The results obtained from this method are relatively easy to interpret and explain.

ZTCM method: This method is based on estimating the relationship between the number of people referring to a place and then the distance of their residential places from the desired place. The advantages of this method include the following (Fleming & Averil, 2008):

- ZTCM method is the only way to express the real reaction of the people about the facilities of the resort.
- The economic value of places and the comparison of their demand curves show the real reaction of the applicant to different places.
- The calculation method used in this method not only measures people's reaction to the existing supply according to economic and social factors but also by further studying the suggestions given by people; we can meet today's needs and predict the community in terms of facilities in different places, and thus, real information will be available to planners for future planning.

- RC Method

The RC method considers the cost incurred by replacing ES with artificial substitutes. This method is based on two main assumptions. First, the cost is not greater than the benefits of ES, and second, the secondary benefits of the replacement system are unrelated. Given these two assumptions, economic valuation is not exaggerated. An important advantage of this method is the ease of estimating cost information and saving time. On the other hand, the limitation of this approach is that alternative costs are not always a reliable measure of the benefits of ES, because artificial technologies do not usually produce all the services that an ecosystem

provides. Accordingly, this method is more suitable for estimating the economic value of a single ES than multiple ES (Notaro & Paletto, 2012).

- HP Method

HP presumes that the price of a good contains the contributions from its several environmental characteristics and inherent (Xu et al., 2016). This method is more reflective of housing changes or land prices. So, using analytical techniques like multivariate regression, the WTP for each feature can be identified. This method is usually used to estimate the value of ES involved in providing welfare and facilities (Badamfirooz et al., 2021). It is recommended to use this method to estimate the benefits attributed to air pollution, water pollution, noise pollution, and access to urban green spaces.

7.5.2.2 Benefit Transfer Method

The benefit transfer method is based on the use of meta-analysis, which according to the results of a number of studies analyzes them in such a way that changes in the results found in those studies can be explained (Azis, 2021). So when there is not enough time to do economic valuation, this method would be suitable. This method uses the average standardized values of ES in each ecosystem, and for this purpose, it estimates the value of different ecosystem services using the Ecosystem Service Valuation Database (ESVD) (Badamfirooz et al., 2021).

7.5.2.3 Stated Preference Method

The basis of the methods of preferential techniques is to create a hypothetical situation for the respondents. This approach includes two methods, which are CV and CE:

- *CV Method*

CV is the most common way to estimate the amount of ES, which uses survey data to directly assess household preferences. In this way, by creating a potential market, respondents are asked to express their willingness to pay for services. This method is called conditional valuation because in this method; people are asked to express their willingness to pay based on description of environmental services and a specific hypothetical scenario. The basis of the method is to describe to the respondents the current state of a nonmarket commodity and how to improve it. They are also asked if they are willing to pay to improve the product (Perez-Verdin et al., 2016). The most important advantages of the CV method are flexibility, which is estimating the economic values of nonmarket interests and considering the values of use and nonuse (Mohammadyari et al., 2018). On the other hand, the subjectivity of the values reported by this method has been introduced as its main drawback (Krause et al., 2017). The CV method contributes to local policy planning by providing

useful information on incentive-based opportunities for preserving natural environments by outlining how much individuals would be willing to pay for different aspects of environmental attributes. Nonetheless, the CV method fails to investigate how hypothetical changes in the quality of a good might affect the future demand of that good. This may be of greater relevance for developing countries whose economy is driven by a tourism industry based on vulnerable natural resources, such as rain forests (Folkersen, 2018).

- *CB Method*

Using the CB method, the revenue effect of a hypothetical future change on the quality of an ES can be estimated. In this regard, the respondents' WTP to visit a natural environment with its current environmental quality is compared with the WTP of individuals to return to the same natural environment in a hypothetical scenario (Folkersen, 2018).

- *CE Method*

The CE method is based on two theories of consumer theory and random utility. In order to economically assess environmental changes in the landscape, this method is usually used, which provides an opportunity to identify the values of changes in the characteristics of environmental goods. This is a benefit for landscape assessment because valuing changes in the valuation of a particular landscape as a whole is more difficult than the individual characteristics that describe a landscape. Eventually, in this method, it is possible to explore the WTP distributions for each feature (Rewitzer et al., 2017). In fact, in this method, which is based on a survey, participants are asked to choose their desired alternative from a set of options that are characterized by different levels of quantitative or qualitative characteristics. Usually the price of the product is one of these features. The great advantage of the CE method is that it not only estimates a value, but it is also able to rate, rank, or select an alternative that provides the greatest utility to the respondent. The main advantage of benefit transfer is to provide a relatively quick assessment of the economic value of ES.

7.6 Conclusions

In this chapter, first, the importance of ES in the welfare of the people are mentioned. Then, the importance of economic valuation of ESs is discussed, and finally, after reviewing the literature, the most widely used methods of economic valuation of ES are introduced. A comprehensive literature review is presented which can be useful for researchers in choosing the appropriate method for ESV studies and in addition can be considered as a guide for future research. As mentioned, ESV is a way to quantify the value of goods and ES, the main purpose of which is to highlight the importance of ES for human well-being and to inform decision-makers and planners in order to better manage system. Although ESV provides useful

information for better ecosystem management, which in turn leads to human well-being, but economic valuation sometimes includes limitations which could be highlighted in two ways: First, the vulnerability of ecosystems has reached the threshold, and it is practically impossible to change them to the previous state, and second, in the case of reversibility, high costs are required. In such cases, economic valuation has a lot of uncertainty. On the other hand, monetary valuation can help to better calculate the costs of land degradation and the benefits of sustainable land management in decision-making. In terms of valuing various ES, international literature seems to have paid the most attention to cultural services. These services are more tangible and obvious than other services. On the other hand, the economic valuation of support services has received less attention than other services, which may indicate a research gap in this type of service. Furthermore, a review of the literature shows that in most valuation studies, the conditional valuation method has been considered and has a long history in ESV that has been able to provide reliable estimates for policymaking. Additionally, the MP method and CE method are the methods that have been used by researchers after the CV method, respectively. Two important advantages of the CV method, namely, ease of evaluation and its flexibility, have made researchers pay more attention to this method. In order to estimate the economic value of goods and services that are not directly defined by market prices, the use of this method is recommended. Because in this method, people express their desire to pay for goods and services in a simulated market. However, one of the main criticisms of this method is that sometimes the results are irrational and uncertain because respondents do not face real budget constraints and tend to say yes very easily. This uncertainty often leads to exaggeration, confusion, unreliability, and ultimately the production of useless information. One way to avoid uncertainty in this method is for respondents to be well-trained. To this end, the concept of value and the reason for the value of goods and services for human well-being must be clarified. In this case, the respondents with the previous background can answer the questions realistically, and so, obviously, in this case, the uncertainty is reduced. We recommend that in future studies the mechanisms of the CV method be reviewed to reduce the limitations of this method and to have more reliable results. Unlike the CV method, the CE method has greatly reduced concerns about uncertainty. Therefore, it can be a good alternative to the CV method. Although both CV and CE are theoretically grounded in the concept of stated preference methods, CE is generally considered to be a superior method. Therefore, if the conditions for the implementation of this method are provided, it is more favorable than the CV method. CE is free from the embedding effect, and different components of an attribute of interest can be experimentally evaluated in the same research setting. Although the purpose of economic valuation, regardless of how it is done, is to assist decision-makers in implementing public policy and environmental planning, but given the new approach to the test method, its optimal ability to evaluate ecosystem services has been confirmed. It is suggested that studies with this method be increased, and it is possible to use it as much as possible. Overall, due to the significant increase in pressure on natural ecosystems, ES valuation studies should be included in future projects. However, even with economic valuation studies, the full

importance of ecosystems is not revealed to us because the economic importance of some ecosystems is still unknown. In this regard, ESV studies can help policymakers develop better strategies to identify essential ES for society, enhance general information on the importance of ES, and decrease the negative impact of parameters such as overgrazing and deforestation.

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