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Euroclima

Guide for the Economic Valuation of Ecosystem Services (VESA)

Ministry of Environment and Energy (MAE)

Expertise France

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PNUD

ONU programa para el medio ambiente

Led by:

El Nuevo Ecuador

Ministerio de Ambiente y Energía

Euroclima

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CREDITS

The Guide for the Economic Valuation of Ecosystem Services (VESA) has been updated and developed with the technical support of Expertise France, within the framework of the EUROCLIMA Programme financed by the European Union. The content of this publication is the sole responsibility of the authors and does not necessarily reflect the views of the European Union.

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Citation
Ministry of Environment and Energy of Ecuador – MAE (2025). *Guide for the Economic Valuation of Ecosystem Services (VESA).* Quito, Ecuador

First edition, 2025

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Acronyms and initials

initials	Meaning
ACB	Cost-Benefit Analysis Protected Areas
AP	Central Bank of Ecuador
BCE	Common International Classification of Ecosytem Services
CICES	Organic Environmental Code
COA	Willingness to Pay
DAP	Willingness to Accept
DAA	Environmental Economics Ecological Economics Expertise France
EA	Decentralized Autonomous Governments
EE	Greenhouse Gases (GHG)
EF	Solid Waste Management and Inclusive Circular Economy Project
GADs	Ministry of Environment, Water and Ecological Transition
GEI	Ministry of Environment and Energy
GRECI	Ministry of Environment of Ecuador
MAATE	Unmet Basic Needs
MAE	Undersecretariat of Environmental Quality
MAE	National Environmental Accounting System Undersecretariat of Climate
NBI	Change
SCA	National Accounts System
SCAN	Environmental and Economic Accounting System
SCC	Geographic Information Systems
SCN	Undersecretariat of Natural Heritage Undersecretariat of Water
SCAE	Resources
SIG	Gross Domestic Product
SPN	National Landscape Restoration Project Environmental and Social
SRH	Remediation Program General State Budget
PIB	Socio Bosque II Program
PNRP	Cuyabeno Wildlife Production Reserve
PRAS	The Economics of Ecosystems and Biodiversity
PGE	Land Use, Land-Use Change, and Forestry
PSB II	Economic Valuation of Ecosyyem Services
RPFC	Net present value
TEEB	
USCUSS	
VESA	
VPN	

MAE: Refers to the Ministry of Environment of Ecuador (MAE), created in 1996 by Executive Decree No. 195. The institution retained this name until 2020. In May 2020, through Executive Decree No. 1017, the Ministry of Environment (MAE) was merged with the National Water Secretariat (SENAGUA), forming the Ministry of Environment and Water (MAAE).

MAE: Also refers to the Ministry of Environment and Energy, established by Executive Decree No. 60 on July 24, 2025, through the merger of the Ministry of Environment, Water and Ecological Transition (MAATE) and the Ministry of Energy and Mines.

MAATE: Refers to the Ministry of Environment, Water and Ecological Transition (MAATE), created on June 5, 2021, by Executive Decree No. 59, which formally incorporated the ecological transition as a central policy axis

Introduction

Ecosystems provide services that sustain, strengthen and enrich human well being. Ecosystem services are the benefits that people obtain directly or indirectly from nature (Kedziora, 2005). Societies, businesses and individuals depend on these services, including the provision of raw materials, water flows for consumption and industry, climate and water regulation, pollutant absorption and pollination, among others (Waage, 2008).

Many of these ecosytem services lack a market price. Consequently, their economic value is often disregarded in decision-making processes, without considering the negative externalities that this omission entails (Waage, 2008; Engel, 2008).

A major challenge for practitioners, researchers, and policymakers lies in determining the economic value of ecosytem services (EVES), that is, in identifying the most appropriate valuation methodologies and applying them across the full range of ecosystem services.

In this context, Article 24 of the Organic Environmental Code (COA) regulates and promotes the economic valuation of ecosystem services. It designates the Ministry of the Environment as the competent authority responsible for validating methodologies, tools and strategies for implementation, in coordination with Decentralized Autonomous Governments (DAGs).

The DAGs are also responsible for promoting the application of valuation studies (Article 27, COA, 2017).

The Ministry of the Environment and Water (MAE) developed this Guide for the Economic Valuation of Ecosystem Services (VESA) as a strategic tool to support decision making for the sustainable and multifunctional management of ecosystems. The guide aims to harmonize trade offs among environmental, economic, social, cultural and governance dimensions, thereby generating economic benefits for both local communities and society as a whole (De Groot, 2007; Balmford, 2002; Stolk, 2006).

This document is organized as follows. Section 1 presents the scope and objectives of the guide. Section 2 describes the types of ecosystem services and provides illustrative examples. Section 3 details the valuation methods and outlines the steps for their application. Sections 4 and 5 present case studies on the economic valuation of ecosystem services undertaken by the Ministry, along with decision trees designed to guide the selection of appropriate valuation methods. Section 6 introduces practical tools to facilitate the valuation process, and Section 7 explains the integration of the VESA Guide into the National Environmental Accounting System (SCAN).

Section 1
Purpose and Scope of the Guide

Scope

It is important to note that this guide is designed as a practical tool for selecting the most appropriate method for the economic valuation of ecosystem services (EVES), based on the specific cases addressed by the various departments of the Ministry of the Environment and Water (MAE).

The document also provides a step by step process for applying each valuation method, supported by bibliographic references that allow users to explore each approach in greater depth.

In addition, the guide includes practical case studies that illustrate the application of these methods in real situations.

Finally, the guide is intended for all technical staff of the MAE, including personnel in the Central Office, Zonal Directorates and Technical Units, as well as for technicians from Decentralized Autonomous Governments (DAGs), academic institutions, policy makers and other stakeholders involved in environmental management..

Legal Basis of the Guide

Since the adoption of the Constitution of the Republic in 2008, nature has been recognized as a subject of rights, reinforcing its central role in conservation and restoration efforts. The Constitution also establishes the obligation of the State to uphold the principles of prevention and *in dubio pro natura*, through the adoption of timely policies and measures to prevent environmental harm. Accordingly, Article 74 provides that:

"People, communities, peoples, and nationalities shall have the right to benefit from the environment and natural resources that ensure good living.

Ecosysyem services shall not be subject to appropriation; their production, provision, use, and exploitation shall be regulated by the State".

The Organic Environmental Code (COA) designates the Ministry of the Environment as the authority responsible for monitoring and evaluating ecosystem services. It also mandates the establishment of mechanisms that comprehensively address biodiversity and ecosystems, including the use of environmental assessment tools and economic analyses to support evidence based public policy and decision making.

On the other hand, Article 256 of the Regulation of the Organic Environmental Code (RCOA) establishes the following:

"Quantification and valuation of ecosysteml services.The National Environmental Authority shall implement a National Environmental Accounting System which, together with the National Forest Monitoring System, the National Forest Inventory, the Unified Environmental Information System and other instruments, will quantify the physical volumes and the annual losses or gains in ecosystem services resulting from changes or degradation in the country's natural ecosystems

o ganancia anual de servicios ambientales derivados de la variación o degradación de los ecosistemas naturales del país. Las metodologías de cuantificación y valoración económica de servicios ambientales deberán ser elaboradas por la Autoridad Ambiental Nacional, bajo estándares científicos, con protocolos verificables, replicables y disponibles a la ciudadanía en general. Su uso será de obligatorio cumplimiento para todos los niveles de gobierno a fin de homologar la cuantificación, reporte y evaluación a nivel nacional".

Background to the Development of the Guide

In 2018, the former Ministry of the Environment of Ecuador (MAE) developed a methodological document for the economic valuation of ecosystem services, in accordance with the provisions of the Organic Environmental Code (COA). The guide was conceived as a technical tool to support the assessment of ecosystem service provision.

Since 2022, the MAE, through the Undersecretariat for Climate Change (SCC), has led national technical assistance within the framework of the EUROCLIMA Programme, financed by the European Union and implemented by the French Agency for International Technical Cooperation, Expertise France (EF). This initiative corresponds to Component 5 of the Land Use, Land Use Change and Forestry initiative, which identifies the updating of the Methodological Guide for the Economic Valuation of Ecosystem Services (EVES) as a priority.

Objectives of the VESA Guide

- Identify the different economic valuation methods using decision trees, allowing users to select the most appropriate method according to the needs of each valuation case study.
- Apply the guide effectively during both the formulation phase (ex-ante) and the implementation phase of a project.
- Apply the guide to estimate the economic value of ecosystem services that have been affected or damaged by various activities (ex-post).

How to use this guide?

Step 1
Identification
of the ecosystem services to be valued.

Step 2
Review
of the key concepts related to the economic valuation of ecosystem services (EVES).

Step 3
Exploration
of the step-by-step application of the methodologies for the economic valuation of ecosystem services (EVES).

Step 4
Analysis
of decision trees based on the identified case studies.

Step 5
Verification
of the tools available to facilitate the application of EVES methodologies.

References - Photo Credits: Shutterstock. Photo 1: Unhappy elderly Indigenous woman in a field. Photo 2: Traveling by boat through the Amazon rainforest in Cuyabeno National Park, Ecuador. Photo 3: Indigenous man swimming in the Amazon rainforest on a handmade boat. Photo 4: Rainforest landscape in Yasuní, Ecuador. Photo 5: Vibrant Amazonian artwork created by the Waorani people of Yasuní, reflecting their rich cultural heritage and exceptional craftsmanship.

Section 2

Types of Ecoystem Services

The economy, health and survival of human societies depend, often indirectly, on natural resources (Reid, 2006). Humanity benefits from a wide range of resources and processes provided by natural ecosystems. Collectively, these benefits are known as **ecosystem services**, the term officially used in Ecuador and widely adopted internationally to describe the benefits that humans obtain directly or indirectly from nature.

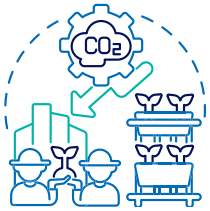
A nivel internacional, este concepto es ampliamente conocido como **servicios ecosistémicos** *(ecosystem services)*, y ambos hacen referencia a los beneficios que los seres humanos obtienen directa o indirectamente de los ecosistemas.

JAs global population and per capita consumption continue to increase, the demand for natural resources has intensified and the impacts of this trend have become increasingly evident. Resources once considered abundant and freely accessible are now becoming scarce or degraded.

Health crises, natural disasters, sanitation challenges and the high cost of replacing nature's regulatory functions through technical means have underscored the need for a more strategic approach to resource use (Liekens, Broekx and De Nocker, 2013).

Although ecosystems and their benefits had been studied for decades, the concept of ecosystem services gained global recognition through the United Nations Millennium Ecosystem Assessment (MEA), a four year study completed in 2005 with the participation of more than 1,300 scientists (Liekens *et al.*, 2013). Los servicios ambientales son aquellos beneficios que un ecosistema provee a los seres humanos. The term 'environmental services' refers to the benefits that an ecosystem provides to human beings. These benefits are the result of natural processes within ecosystems (MAE, IUCN & GIZ, 2018). Environmental services can be categorised into the following four types: provisioning, supporting, regulating and habitat services.

Provisioning Services



These services are provided by ecosystems in the form of products or goods that are consumed by people or used in the production of other goods. They include food, medicinal resources, raw materials, ornamental species and fresh water (UNEP, 2014). Many provisioning services are traded in markets, while numerous communities depend directly on natural resources for their subsistence. Examples include the use of wood and leaves for building houses, the collection of forest fruits and fishing in rivers (MAE, IUCN and GIZ, 2018; GIZ and Helmholtz, 2013 to 2018; BISE, 2023).

Regulating Services

These services encompass the benefits derived from the regulatory functions of ecosystems, which influence natural processes such as climate regulation, disease control, erosion prevention, water quality and quantity, pollination and protection against natural disasters. Key examples include climate regulation, carbon sequestration, moderation of extreme events, wastewater treatment, erosion control, soil fertility maintenance, pollination and biological pest control (UNEP, 2014; GIZ and Helmholtz, 2013 to 2018; BISE, 2023).

Supporting and Habitat Services

These services include the fundamental ecological processes that sustain life, such as nutrient cycling and primary production, which also support other ecosystem services. They involve the maintenance of habitats for species and the conservation of genetic diversity (UNEP, 2014; GIZ and Helmholtz, 2013 to 2018; BISE, 2023)

Cultural Services

Also known as intangible services, these include the *non-material* benefits that people derive from ecosystems, such as recreation; spiritual experiences; nature tourism; intellectual development and aesthetic appreciation; and inspiration for culture, art and design (UNEP, 2014; GIZ & Helmholtz, 2013-2018; BISE, 2023).

Examples of Ecosystem Services of Ecuador

Below are examples of the different types of ecosystem services in the Ecuadorian context.

• Provisioning Services

Crabs harvested from mangroves along Ecuador's coast, legumes produced by the guarango tree, timber extracted from forests, fresh water transformed into drinking water for human consumption and amphibians used as genetic resources in biotrade, biopharmaceutical processes and research are examples of provisioning services (Water Protection Fund FONAG, 2006; MAE, GIZ, 2017; UNEP, 2014).

• Regulating Services

• Calidad del aire

Guangüiltagua Metropolitan Park plays an important role in maintaining air quality in the city of Quito (Corona and Martínez, 2023).

• Water regulation and pollination

Forest conservation helps reduce runoff and erosion, preventing flooding. Pollinators such as flies, butterflies, wasps, bees, hummingbirds and bats are essential for plant reproduction, transferring pollen from one flower to another (MAE, GIZ, 2017)

• Coastal protection and carbon capture

Mangroves protect coastal areas from flooding and storms by acting as natural barriers. In addition, forest conservation, reforestation and the restoration of degraded soils promote carbon sequestration and help mitigate climate change by removing greenhouse gases from the atmosphere (MAE, GIZ, 2017; Corona and Martínez, 2023).

• Supporting and Habitat Services

National parks, marine reserves, ecological and biological reserves, flora and fauna production reserves, wildlife refuges and natural recreation areas are essential for maintaining ecosystem functions and services. These areas also play a key role in preserving genetic diversity, i.e. the variety of genes between species and within populations. This diversity is fundamental to developing crops that are adapted to local conditions, as well as improving agricultural and livestock species. (MAE, IUCN and GIZ, 2018).

• Cultural Services

Activities such as hiking on the Pasochoa Volcano or around the Cuicocha Lagoon, diving and snorkeling in the Galapagos Islands, observing pink dolphins in the Cuyabeno Wildlife Production Reserve and engaging with the traditions of Amazonian Indigenous nationalities illustrate how ecosystems provide meaningful recreational, aesthetic, spiritual and cultural experiences (Kinh Bac *et al.*, 2022).

Provision	Water	Fresh Water	Ecosystems play a key role in providing freshwater by ensuring its flow, storage, and purification.
	Biomass	Food	Ecosystems supply a wide variety of materials for construction and fuel derived from plant species.
		Raw Materials	Ecosystems provide plants used in traditional medicine and as raw materials for the pharmaceutical industry.
		Medicinal resources	Ecosystems offer plants used as traditional medicines, as well as raw material for the pharma industries.
Regulation	Transformation of biochemical and physical contributions into ecosystem benefits	Air quality regulation	Trees and other plants remove pollutants from the atmosphere.
		Wastewater treatment	Wetlands filter effluents and decompose waste through the biological activity of soil microorganisms.
		Noise reduction	Vegetation helps reduce noise levels and improves human well-being.
	Regulation of physical, chemical, and biological conditions	Moderation of external events	Ecosystems act as natural buffers against floods, storms, and other extreme weather events.
		Waterflow regulation	Vegetated areas reduce runoff and enhance water infiltration.
		Erosion prevention	Vegetation covering prevents soil erosion.
		Climate regulation	Trees lower urban temperatures, and forests influence rainfall and humidity at local and regional scales.
		Carbon capture and storage	Ecosystems store greenhouse gases (GHGs) by absorbing carbon dioxide and sequestering it in plant biomass.
		Soil fertility maintenance	Healthy ecosystems recycle nutrients essential for plant growth and agriculture.
		Pollination	Insects, birds, bats, and wind enable plant reproduction, ensuring the development of fruits, vegetables, and seeds.
		Biological control	Ecosystems regulate pests and diseases through natural predators and parasites.
Cultural	Interactions with live systems	Spiritual experiences	Nature-based traditions strengthen identity and a sense of belonging.
	In situ and external interactions with living systems.	Inspiration for culture and art	Biodiversity and landscapes have long influenced art, culture, and science.
		Physical and mental recreation	Activities such as walking or outdoor sports promote health and relaxation.
		Tourism	Ecosystems support various forms of tourism, contributing to economic and cultural development.
Support	Habitat	Habitat for species	Each ecosystem offers unique spaces critical for the life cycles of species.
		Maintenance of genetical diversity	Genetic diversity distinguishes species and serves as a reservoir for developing locally adapted crops and improved agricultural and livestock breeds.

Table 1. Classification of Ecosytem Services
Source: CICES; TEEB; Croci et al., 2021.

Table 1 Table 1 presents a summary of the correspondence between the ecosystem services identified in the **Common International Classification of Ecosystem Services (CICES)** and those considered under the **Economics of Ecosystems and Biodiversity (TEEB)** initiative

The first column presents the classification of ecosystem services proposed by CICES.

The second column lists the categories adopted by TEEB, and the third column provides the definitions of each service as described by TEEB. In the cases of noise reduction and regulation of water flows, the definitions are drawn directly from CICES, since these services are not explicitly included in the TEEB classification (Croci *et al.,* 2021).

Section 3

Economic Valuation of Ecosytem Services

Ecosystem services are a fundamental component of human wellbeing worldwide. For this reason, it is essential that the **National Environmental Authority** assign due importance to the **natural capital reserves** generated by these services, ensuring that they are carefully considered in decision making processes. Failure to do so jeopardizes the well-being of both present and future generations (Costanza *et al.,* 1997).

Contextualization: Environmental Economics and Ecological Economics

Vision of Environmental Economics (EE)

Environmental economics is grounded in the principles of neoclassical economics. It assumes that natural resources can be considered a form of natural capital and that their valuation can be integrated into traditional cost–benefit analyses. Within this framework, encosytem services are incorporated as economic variables in existing models through tools such as shadow pricing, contingent valuation, and avoided cost analysis. The main objective is to internalize environmental externalities in the market to achieve a more efficient allocation of resources (Pearce, 1985; Aguilera-Klink & Alcántara, 1994).

Vision of Ecological Economics (EE)

Ecological economics is grounded in the principle that the economy functions within a larger system, the biosphere. It recognizes that the planet's biophysical limits define and constrain economic activity, and that not all values can or should be expressed in monetary terms. Rather than seeking efficiency through markets, ecological economics emphasizes **ecological sustainability and intergenerational justice**, advocating for a transdisciplinary approach that integrates the natural sciences, economics, and environmental ethics (Martínez-Alier, 1998).

These two perspectives are summarized in **Diagram 1**, which illustrates the main conceptual differences between **environmental economics** and **ecological economics** in relation to the economic valuation of ecosystem services.

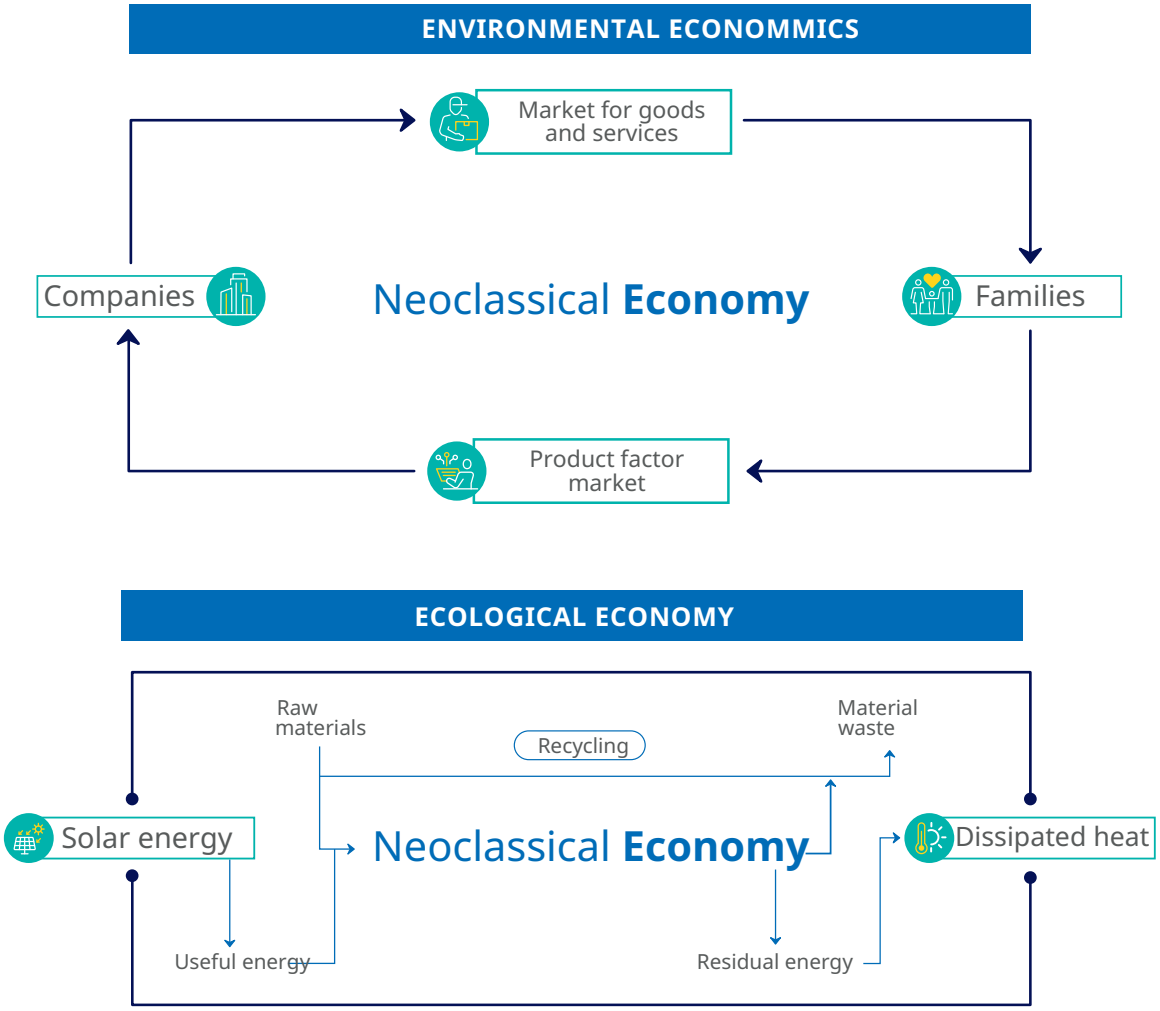


Diagram 1. Differences Between Environmental Economics and Ecological Economics Source: Martínez-Alier, 1998

From the standpoint of ecological economics, this perspective holds that planet **Earth functions as a closed system with respect to the flow of materials but remains open to the flow of solar energy.** It seeks to explain the limits to economic growth defined by the *law of entropy*, which governs natural phenomena and involves an irreversible process of **degradation of matter and energy** (Leff, 2004). This approach incorporates key biophysical concepts and emphasizes that the economy cannot be separated from the natural laws that govern these processes of degradation.

One of the key conceptual foundations of ecological economics originates from **Georgescu-Roegen** (1971: 353), widely regarded as the founder of this discipline. He argued that "the economic process is entropic: it neither creates nor consumes materials or energy but merely transforms low entropy into high entropy." In this view, production is understood as an irreversible process of **entropic degradation.**

This ecological and physical understanding of the economy contrasts with the perspective of environmental economics, which seeks to **assign monetary values to ecosytem services**. In contrast, ecological economics challenges the reduction of nature to monetary terms. Within the framework of this guide, the adopted conceptual foundation is that of **environmental economics**, ensuring that the methodologies developed respond to the operational needs of the **Ministry of Environment and Energy (MAE)** across its different areas of action.

Why is it Important to Value Ecosytem Services?

The valuation of ecosystem services makes it possible to better understand their **economic importance** and to highlight their relevance in decision making processes.

Assigning monetary value to these services supports their inclusion in public policies, planning instruments and conservation strategies.

According to Bagstad et al. (2014), the valuation of ecosystem services is fundamental to **biodiversity conservation**, since services such as pollination, water purification and climate regulation are essential for the survival of countless species. This process also supports the recognition and protection of **sensitive ecosystems**.

According to Costanza et al. (1997), the valuation of ecosystem services helps quantify the **benefits that ecosystems** provide to society by assigning them a monetary value that informs and strengthens policy decision making. This approach complements traditional analyses by integrating environmental benefits and socioeconomic objectives, thereby improving the evaluation of natural resource management and use options.

Barbier (2011) argues that the economic valuation of ecosystem services helps **prevent their overexploitation**. Recognizing their contribution to human well-being reduces the risk of undervaluation and inefficient use. Furthermore, this approach allows for the **quantification of costs** and benefits associated with different resource-use decisions, thereby promoting more sustainable and equitable management.

The Millennium Ecosystem Assessment (2005) underscores that valuing ecosystem services is crucial for informed decision-making. Expressing their value in monetary terms supports the formulation of policies that foster the conservation and sustainable use of ecosystems.

Finally, Daly (1997) emphasizes that the economic valuation of ecosystem services reveals society's profound dependence on natural systems. Assigning a monetary value to these services helps acknowledge both their direct and indirect contributions to human well-being, including the provision of food, clean water, climate regulation, protection from natural disasters, and cultural and recreational benefits.

In summary, the economic valuation of ecosytem services enables the quantification and recognition of the benefits that ecosystems provide to society. This information serves as a key input for the formulation of public policies, the prevention of overexploitation, and the effective communication of their importance to the various stakeholders involved.

Conceptual Framework

1. Economic Value and Price

Economic value is expressed in monetary terms and is based on individual preferences. It represents the level of well-being that an individual or society derives from interacting with a good or service within a specific context.

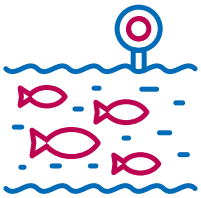
In contrast, **price** refers to the monetary amount at which a good or service is exchanged in the market, determined by the laws of supply and demand. It reflects the amount that buyers are willing to pay, and sellers are willing to accept for a particular good or service.

2. Market Failures

Market failures occur when the market, by itself, fails to allocate resources efficiently. The main types of market failure relevant to the valuation of ecosysyem are outlined below.

Externalities: Externalities refer to the impact of one person's actions on the well-being of others, without any corresponding payment or compensation. They can be positive or negative and may arise from both the production and consumption of goods or services (Mankiw, 2012).

Example: A sewage company discharges untreated gray and black water into a river. Downstream farmers and local communities use this water for consumption. This represents a **negative externality.**



Public goods: Public goods are non-excludable and non-rivalrous, meaning that no one can be prevented from using them, and one person's use does not reduce their availability to others.

Example: **Public parks** or urban **green spaces**, as everyone can enjoy them, and their use by one person does not prevent others from doing so.

Common resources: They are rivalrous in consumption but non-excludable. This means that although use by one person reduces their availability to others, it is difficult to prevent anyone from accessing them. In the absence of regulation, such resources are at risk of overexploitation or depletion.

Example: **Fish in the ocean**, since when one person fishes, the stock available to others decreases. However, due to the vastness and openness of the sea, it is difficult to restrict access to other fishers.

3. Welfare Measures

Welfare economics examines how the allocation of resources influences economic well-being by analyzing the effects of changes in the prices or quantities of goods and services on the quality of life of individuals and societies (Mankiw, 2012).

Consumer surplus

It is the difference between the amount a buyer is willing to pay for a good and the amount actually paid.

It represents the buyer's willingness to pay, that is, the maximum amount they are prepared to spend on that good.

Producer surplus

It is the amount that a producer receives in excess of production costs.

It reflects the benefit that sellers gain by participating in a market where the minimum price they are willing to accept is lower than the price actually received.

Importance of the Economic Valuation of Ecosystem Services

From the perspective of environmental economics (EE), the economic valuation of the environment begins with the distinction between use values and **non-use values** associated with natural ecosystems. These are grouped under the concept of **Total Economic Value (TEV).**

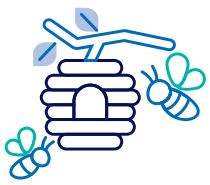
- **Use value** refers to the benefits derived from the direct, indirect, or potential (future) use of natural resources.
- **Non-use value** refers to the existence or preservation of natural resources, whether for the well-being generated by their mere existence or for the desire to conserve them for future generations.

This type of value is more complex to measure, which can make it difficult to properly integrate into valuation processes (Moreno *et al.*, 2020).

This approach recognizes that effective management of natural resources is essential to mitigate degradation and environmental impacts. To this end, various methods and techniques are available to estimate their economic value (Llanes, 2012).

Total Economic Value (TEV)
The total economic value of an ecosystem integrates the different types of values associated with its uses and benefits and can be expressed as follows:

Total Economic Value (TEV)
= Direct Use Value + Indirect Use Value + Option Value + Existence Value + Bequest (Legacy) Value



Direct Use Value: Refers to the monetary value derived from the direct use of natural resources and services. It represents the environmental functions that can be traded in goods and services markets.

Examples: Fishing, agriculture, tourism, and the use of timber, seeds, and other marketable resources.

Indirect Use Value: Encompasses ecosystem functions that, by their nature, do not have a direct market presence but are essential to the operation and regulation of ecosystems.

Examples: Nutrient retention, carbon sequestration, flood control, water purification, and crop pollination, among others.

Option Value: Refers to the economic value associated with the possibility of using or benefiting from an ecosystem service in the future. It is linked to the uncertainty surrounding its use by current or future generations, whether directly or indirectly.

Example: The water quality of a source that could be used in the future.

Existence Value: Recognizes the intrinsic, spiritual, or emotional value that an ecosystem represents for people, independent of its use. This value reflects the ethical and cultural importance of conserving nature.

Exemples: Conservation of national parks and coastal–marine ecosystems, among others.

Bequest (Legacy) Value: Represents the willingness to pay to ensure the availability of natural resources for future generations. It reflects a sense of intergenerational responsibility and, in some cases, a philanthropic motivation.

Example: Protection of natural habitats to preserve them for future generations.

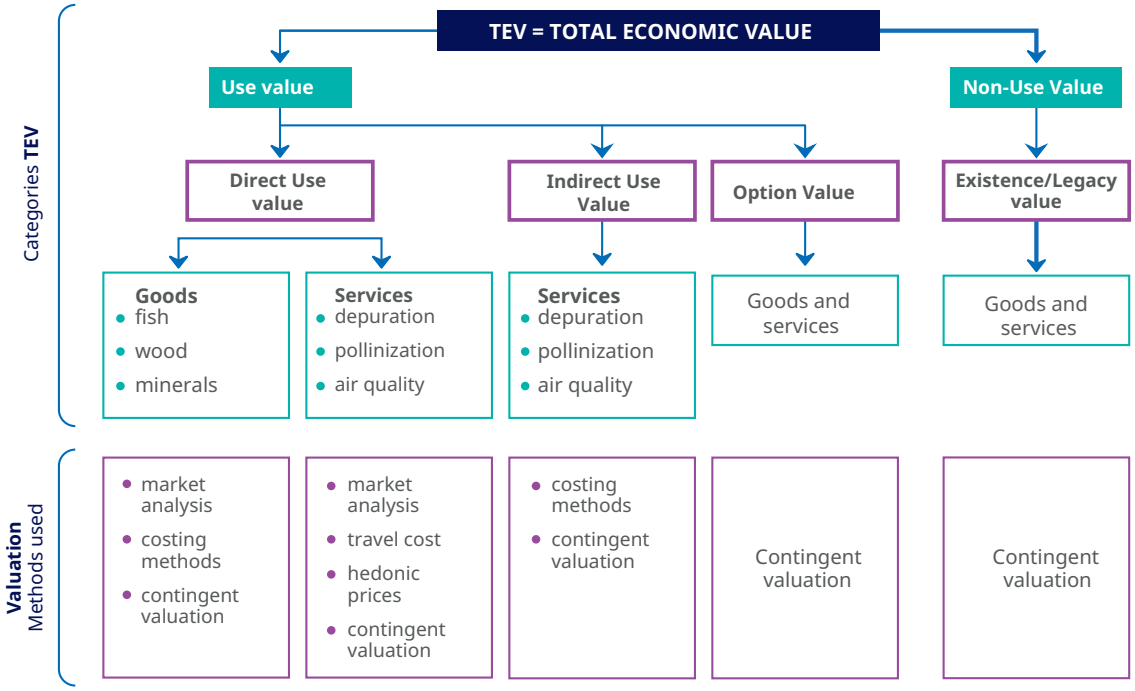


Diagram 2. Total Economic Value[1]
Source: Llanes, 2012; Obeng *et al*., 2020

[1] The next section offers additional details on environmental assessment methodologies.

Section 4

Description of Valuation Methodologies

Valuation methodologies provide robust arguments for protecting ecosystem services and enhance the understanding of ecosystems by assessing the costs and benefits derived from decisions related to development and environmental management, considering both resources and their utility values (Rasul et al., 2011).

The economic valuation of ecosytem services plays a crucial role in decision-making, particularly in setting priorities for the allocation, distribution, and management of resources. In many countries, including Ecuador, investment decisions in public works, such as hydroelectric plants, roads, and other como hidroeléctricas, carreteras u infrastructure, often overlook the potential impacts and actual economic implications these activities may have on the environment and local livelihoods. In this context, assigning economic value to an environmental service makes it possible to compare the benefits associated with those services with the economic value of alternative uses of land or resources (Rasul *et al.*, 2011).

The purpose of this section is to describe the main economic valuation methodologies, explaining the steps for their application and providing references for further study of each one.

Market Pricing Methodology

This methodology applies to environmental goods and services that are traded in the market, such as provisioning services (Lee *et al.*, 2022). A common example is estimating the value of grazing services based on the commercial value of pasture (Jamouli & Allali, 2020). This approach makes it possible to estimate the value of services directly using observable market prices.

The market price represents the value of an additional unit of a good or service, assuming a perfectly competitive market in which there is complete information, homogeneous products, and no taxes or subsidies (King & Mazzotta, 2000).

In other words, this method evaluates changes in the quantity or quality of a good or service according to the actual willingness to pay of producers and consumers as reflected in market prices.

However, this approach captures only use values and applies solely to goods and services with observable prices. It does not allow for the valuation of services such as water purification or soil fertility, and it is often less effective when applied on a large scale or in contexts with incomplete markets (Carson & Bergstrom, 2003).

Steps for Applying Market Pricing Methodology

Step 1. Identify the environmental service to be valued

Each environmental service has distinct characteristics that determine the most appropriate valuation approach.

Step 2. Collect relevant market price data

Gather market prices directly associated with the service. For example, to estimate the value of timber supply services, it is necessary to obtain information on the selling prices of the relevant timber species.

Step 3. Depurar y ajustar los datos

Correct any errors or biases in the data and account for factors that may influence price variation, such as quality, seasonality, and geographic location.

Step 4. Identify the relationship between the environmental service and market prices

Analyze how ecosystem services influence the prices of related products or services. For instance, when assessing the effect of water quality on fishing, variations in the prices of fishery products linked to water quality should be examined.

Step 5. Estimate the economic value of the environmental service

Apply appropriate statistical or econometric techniques, depending on data availability and the required level of analytical detail.

Step 6. Validate the results

Evaluate the robustness of the estimates through sensitivity analyses or by comparing the results with previous studies (Pagiola et al., 2003; Costanza et al., 1997).

Case Studies Applying the Market Pricing Methodology

Using Market Prices to Value the Environmental Benefits of Marine and Coastal Reserves in Ecuador

This study aimed to estimate the economic value of four marine and coastal reserves in Ecuador using market prices. Two services were evaluated:

- **Artisanal fishing** production permitted within protected areas, estimated using the market price method.

- **Carbon storage** is valued using the benefit transfer method based on the dry biomass of the forests within the reserves.

The results showed that the total economic contribution of these reserves reached **USD 105 million**, with artisanal fishing accounting for the largest share at **USD 100.09 million**. Esto constituyó un

This activity provided a direct benefit to approximately 6,800 families, with average annual incomes of **USD 14,720.18**, well above Ecuador's GDP per capita in 2016 (**USD 5,968.98**).

Carbon storage contributed USD 5.3 million, calculated using the World Bank's carbon market reference price. The combined economic benefits represented **0.35% of the General State Budget (PGE) and 0.1% of Ecuador's gross domestic product (GDP)** for that same year.

This case illustrates that market prices are a practical and effective tool for valuing environmental goods and services in marine and coastal protected areas (Chain *et al.*, 2018).

Study Using Market Prices in Fisheries (Kenya)

McClanahan (2010) examined the effects of implementing fishery closures and gear2 restrictions on **the long-term profitability** of coral reef fisheries in Kenya. The study analyzed price trends by taxonomic group (species) and product type (fresh fish, canned fish, etc.), as well as the relationship between fish size and price, to estimate profits under three management scenarios:

1. Fishing gear restrictions only.
2. Combined gear and zone restrictions.
3. Unrestricted fishing

The analysis covered a twelve-year period and compared sites with **varying levels of management:** intensive, moderate, and none. The following aspects were evaluated:

A) Catches

Catches were classified into six taxonomic groups used locally for pricing. Their size, weight, and composition were analyzed.

B) Prices

The average monthly price per kilogram of fish in each category was recorded.

[2] The main fishing methods include trawling, seine nets, longlines, almadrabas, and live-bait rods and handlines.

C) Revenues

The average annual price was multiplied by the average annual catch per unit of effort (number of fish caught per defined period) to estimate both category-specific and total revenues. The study assumed **306 fishing days per year**, excluding Fridays and days with extreme weather conditions.

D) Costs

Capital investment and operating costs were assessed at the beginning and end of the study. Only purchased materials were considered, as no engines or fuel were used, and a constant level of fishing effort per person was assumed.

Key results

- Areas with **fishing restrictions** showed an approximate **50%** increase in profitability.
- This rise in profits was attributed to the fact that restrictions enabled the capture of **larger fish**, which commanded higher prices per kilogram.
- Closed seasons promoted the recovery of valuable species, resulting in higher profits per fisher.

Advantages and Limitations of the Market Price Valuation Methodology

The market price methodology is a widely used tool for valuing environmental goods and services in the field of environmental economics. However, its application presents both advantages and limitations.

Advantages

- **Objectivity and quantification.**
  Provides an objective and quantifiable estimate of the value of environmental goods and services, facilitating decision-making through values expressed in monetary terms.

- **Comparability.**
  Enables comparisons between ecosytem and other assets or resources, helping to prioritize investments and public policies through cost–benefit analysis.

- **Widespread acceptance.**
  Its use is easily understood and accepted by economic actors, legislators, and decision-makers, as it aligns with the functioning of market economies.

- **Efficiency and speed.**
  Collecting market price data is often faster and less costly than alternative methods such as surveys or experimental studies.

- **Applicability in developed markets.**
  It is especially useful when there are established markets for goods and services such as timber, water, or energy (Christie *et al.*, 2012).

Limitations

- **Lack of markets or market imperfections.** Many ecosystem lack a specific market or operate in imperfect ones, which limits the applicability of this method.
- **Externalidades y bienes públicos.** The method does not adequately capture indirect impacts or non-traded benefits—such as air quality or biodiversity—that are characteristic of public goods.
- **Bias towards marketable goods.** It tends to overvalue goods with established market prices and undervalue essential services that are not traded, which can negatively influence conservation decisions.
- **Volatility and price distortion.** Market prices may fluctuate due to economic or political factors and do not always reflect true ecological or social value.
- **Ausencia de valoración cultural o ética.** No incorpora las preferencias individuales o los valores simbólicos o éticos, lo que puede resultar en una subvaloración de ecosistemas relevantes desde el punto de vista cultural o espiritual (Christie *et al*., 2012).

Referencia recomendada para ampliar información

- Christie, M., Fazey, I., Cooper, R., Hyde, T., & Kenter, J. (2012). An evaluation of monetary and non-monetary techniques for assessing the importance of biodiversity and ecosystem services to people in countries with developing economies. *Ecological Economics*, 83, 67–78.

Benefit Transfer Methodology

The benefit transfer method allows the estimation of the economic value of ecosystem services in a target area (policy or intervention site) using values obtained from previous studies carried out in locations with similar characteristics. This approach is useful when resources are not sufficient to conduct a primary valuation study, since it reduces both cost and time (Read *et al*., 2022; TEEB, 2010).

Conditions Necessary for an Appropriate Transfer

According to Rosenberger & Loomis (2001), the following requirements must be met:

1. Definition of the policy site

• Clearly defined geographical and biophysical boundaries.
• Precise identification of the ecosystem services to be assessed.
• Definition of the target population and its socioeconomic and institutional context.
• Data collection using compatible measurement units and value types (use or non-use) as required.

2. Características del sitio de estudio

- Primary studies must have been conducted using valid and rigorous methodologies.
- The relationships among costs, socioeconomic characteristics, and environmental conditions must be well documented.
- Multiple studies on the same type of environmental service are recommended to obtain a more robust estimate.

3. Correspondencia entre ambos sitios

- Similarity in ecosytem services and resources.
- Comparable or adjustable market conditions.
- Reasonable correspondence in demographic, cultural, and income characteristics

In many cases, primary studies do not provide all this information, making it essential for researchers to recognize the potential limitations and biases when performing the transfer (Rosenberger & Loomis, 2001).

Steps for Applying Benefit Transfer Methodology

Step 1. Case description

- Define the policy, project, or intervention.
- Identify the ecosystem services that could be affected.
- Establish a baseline for current service flows.
- Describe the expected changes in ecosystem service flows.
- Characterize the benefits of these services.

Step 2. Selection of information from the study site.

- Gather information from relevant previous studies.
- Assess the quality and relevance of the estimated values.
- Select measurement units consistent with those used at the policy site.
- Determine the most appropriate transfer method:
  - Unit value transfer (simple adjustment for quantity or population).
  - Value function transfer (using a valuation function adjusted for site characteristics)
- Estimate the economic value for the policy site.
- Aggregate values by affected population and changes in service provision.
- Evaluate the margin of error and uncertainty of the study (Brander, 2013).

Case Studies Applying the Benefit Transfer Methodology

The Value of Nature in the Térraba-Sierpe National Wetlands: The Essential Economy of Ecosytem Services

The **Térraba-Sierpe National Wetlands,** located on the Osa Peninsula in Costa Rica, were evaluated using the benefit transfer technique developed by Earth Economics (2010). The study estimated the **annual present value of ecosytem services to range from USD 302.3 million** (conservative estimate) **to USD 1.93 billion (high estimate)**.

The services considered included storm protection, drought mitigation, nutrient cycling, biodiversity, habitat provision for piangua (bivalves), and aesthetic benefits, among others. The process began with mapping through Geographic Information Systems (GIS) to estimate the number of hectares by vegetation type.

Subsequently, per-hectare value estimates from peer-reviewed scientific literature were adjusted to the local context of the Térraba-Sierpe wetland and discounted to obtain their present value. The valuation served as a key input for the **National Wetlands Management Plan**, completed in 2008 with community participation.

The study concluded that **understanding the economic value of wetlands is a critical step** toward effective management and justifying the mobilization of national and international financial resources for their conservation (Earth Economics, 2010).

Economic Valuation of the Main Ecosystem Services of the Tibanica Wetland (Bogotá, Colombia)

The **Tibanica Wetland**, located in Bogotá, Colombia, has been subjected to multiple anthropogenic pressures, posing significant challenges for its conservation and management. In this context, an economic valuation of its ecosystem services was conducted using **the benefit transfer methodology based on value functions**.

Ecosytem services were identified through a participatory checklist, after which pre-existing benefit (demand) functions from previous studies were applied.

Among the services evaluated, the most significant were **erosion control, water supply, and habitat provision for native species.**

The estimated economic value of these services was **USD 111,557.14 per year**, highlighting the ecological and economic importance of the wetland and reinforcing the need to integrate it more actively into territorial planning and management instruments (Iwan *et al*., 2017).

Advantages and Limitations of the Benefit Transfer Methodology

Advantages

The benefit transfer methodology offers several advantages that make it a widely used tool, particularly in contexts with limited resources.

- **Cost and time efficiency.**
  Cost and time efficiency. It is one of the few viable methodologies when there are constraints related to time, budget, or access to primary data. It can be applied even in contexts with administrative or logistical limitations that prevent the implementation of original valuation studies (Johnston et al., 2015; Richardson *et al.*, 2015; Iovanna & Griffiths, 2016).
- **Usefulness for decision makers.**
  It provides reasonable estimates of the economic value of ecosystem services to inform policy decisions, planning processes, and intervention design, without the need for extensive valuation studies.
- **Methodological flexibility**
  It can be applied using simple value transfers (unit value transfer) or more complex functions (value function transfer), adapting to the level of available information and the analytical requirements of each case.

Limitations

Despite its advantages, this methodology also presents important challenges and risks that must be considered when applying it.

- **Riesgo de sesgos.** Benefit transfer may yield biased results due to weaknesses in the original studies, significant contextual differences between the study and policy sites, or methodological errors in extrapolation (Carriazo & Ibáñez, 2003).
- **Quality of primary studies.** Errors often arise when transferred values are derived from studies with limitations in data quality, methodological design, or transparency in reported assumptions (Rosenberger & Loomis, 2001).

o en la transparencia de los supuestos empleados (Rosenberger & Loomis, 2001).

- **Contextual and temporal differences.**
  Estimates may become inaccurate if there are significant discrepancies between:

  I. the physical and socioeconomic characteristics of the environmental service at both sites,
  II. market conditions,
  III. the availability of substitute goods,
  IV. the time frames of the studies (Rosenberger & Loomis, 2001; Carriazo & Ibáñez, 2003; Osorio, 2006).

- **Lack of methodological standardization.** When original studies use different or non-comparable valuation techniques (e.g., contingent valuation versus hedonic pricing), the results of benefit transfer may become inconsistent.

- **Number and representativeness of available studies.** A limited number of suitable studies or a lack of key methodological details can restrict the reliability of the transfer process.

Despite these challenges, the economic literature has not yet provided clear empirical evidence indicating which approach performs better in terms of estimation accuracy (Brouwer, 2000; Carriazo & Ibáñez, 2003).

Recommended Reference for Further Information

- Brander, L. (2013). *Guidance Manual on Value Transfer Methods for Ecosystem Services.* United Nations Environment Program (UNEP). Nairobi, Kenia.

Economic Valuation Using the Replacement Cost Methodology

The **replacement cost** methodology estimates the economic value of ecosytem services by calculating the expenses required to **restore an ecosystem** to its natural state or **to replace** the services lost due to environmental degradation. This approach assumes that **the cost of restoration reflects the economic value of the degraded resource or service** (Sundberg, 2004; Toledo & Briceño, 2018).

It applies both to site-specific environmental restoration contexts, such as an oil spill, and to long-term recovery processes, such as the natural regeneration of forests in areas degraded by overgrazing (Kaval, 2010; Talberth, 2015)

This method relies on **market prices** to estimate replacement or recovery costs. For example, the value of a forest may be approximated by the cost of replanting it (Quillérou, 2019), while the value of wastewater treatment can be inferred from the cost of building and operating a treatment plant (Bouma & Pieter, 2015)

The approach is particularly useful for assessing **ecosystem services that have technical or artificial equivalents,** such as aquifer recharge, water filtration, flood protection, or soil retention.

Steps for Applying the Replacement Cost Methodology

Step 1. Evaluate the environmental service provided

Identify the specific service, its mode of provision, and its beneficiaries.

For example, in the case of flood protection, the magnitude of potential flooding and its likely impact on people and property must be assessed.

Step 2. Identify the alternative of most profitable replacement
Select the technically feasible and least costly option to replace the ecosystem service. This alternative may involve gray infrastructure, nature-based solutions, or a combination of both.

Step 3. Calculate the cost of the selected alternative
Estimate the direct and indirect costs of replacement or restoration, including initial.

investment, operation, maintenance, and any associated externalities.

Step 4. Validate social acceptability o
Gather evidence showing that users or beneficiaries would accept the replacement service as equivalent to the original ecosystem service (Bouma & Pieter, 2015). This validation can be carried out through public consultations, surveys, or preference analyses.

Case Studies Applying the Replacement Cost Method

Economic Valuation of Mangroves in the Southern Sector of the Cayapas-Mataje Mangrove Ecological Reserve (REMACAM), Near Shrimp Farms

This study applied the **replacement cost** method to estimate the economic value of the southern portion of REMACAM, located in the parish of La Tola, Ecuador. Data collection tools included interviews with local stakeholders, surveys, water quality monitoring (of shrimp farm influent and effluent), and evaluations of mangrove management and conservation status.

The conservation status of the ecosystem was determined to be 76.42%. Based on this assessment, the study estimated a **restoration compensation** of approximately **USD 54,583,766.66**, to be implemented over a nine-year period as a replacement measure for the impacts caused by shrimp farming (Bravo, 2018).

Economic Assessment of Fire Damage in the Private Conservation Area (PCA) "Milpuj – La Heredad," Peru

Dry forest ecosystems in the inter-Andean valleys of northeastern Peru are among the most important biogeographic regions in the Andes, as they host numerous endemic species of flora and fauna. However, due to anthropogenic pressures such as land clearing through burning to expand agricultural and livestock frontiers, logging, hunting, and land

invasions, these ecosystems, and the ecosytem services they provide are increasingly threatened and degraded
Despite the efforts of private landowners to conserve biodiversity through sustainable use and restoration models, there is still limited engagement in biodiversity protection. External actors continue to pose threats to these areas.

Consequently, an economic assessment of the damage to natural resources was conducted to quantify, in monetary terms, the losses associated with both use and non-use values. The objective was to establish appropriate compensation for the loss of productive resources and the costs of cleanup and restoration following the fire that occurred in the Milpuj – La Heredad Private Conservation Area (ACP).

The economic value of the damage was determined by summing the costs of the damage, the expenses related to restoration measures, and the estimated economic value of the dry forest's ecosytem services. The cost of restoring the ecosystem to its original state after anthropogenic disturbance provides an approximation of the value of the altered environmental benefits.

To this end, damaged resources were identified, and replacement or restoration costs were estimated based on reforestation activities.

The restoration cost associated with reforesting the area affected by the fire in the Milpuj – La Heredad ACP was calculated at S/ 13,682.75 (USD 3,563.38). Finally, the cost of the damage and restoration was calculated, and the non-use value of this type of ecosystem was estimated using Costanza *et al.* (1997) ecosystem services map. It was determined that the total economic value of the damage caused to the affected 23.46 hectares is equivalent to S/ 210,279.67 (USD 54,762.78), or S/ 8,963.33 (USD 2,334.30) per hectare (Casiago *et al.*, 2018).

This method can also be applied to landscape-scale restoration assessments, as well as to estimate replacement costs for technologies such as wastewater treatment systems.

Advantages and Limitations of the Replacement Cost Methodology

Advantages

It is a simple and resource-efficient methodology, making it easy to apply even in countries with limited technical capacity and data availability (Pearce & Turner, 1991).

Limitations

Its reliability depends largely on the quality of the available data, as inaccurate values can lead to errors in estimating the value of the natural resources (Pearce & Turner, 1991)

Recommended Reference for Further Information

- Bouma, J. A., & Van Beukering, P. (2015). *Ecosystem Services. from Concept to Practice*. Cambridge University Press.

Travel Cost Methodology

This methodology estimates demand for a given location using various economic and statistical models. For example, it can be used to assess the recreational benefits of Cotopaxi National Park. Travel expenses include both the costs incurred to reach the park (e.g., fuel, guide fees, and other visit-related expenses) and time-related costs (e.g., the value of visitors' time spent in the area). This information, along with the frequency of visits to the site, is obtained through questionnaires (UNEP, 2014).

Since the travel cost method relies on visitor interviews and surveys, it is essential to apply diverse sampling strategies to ensure that the sample is statistically representative. For instance, surveys should be conducted at different times of the year and, when relevant, among different groups of visitors, both national and international, across various areas of the site and considering its different uses (*Ibid)*.

Steps for Applying the Travel Cost Methodology

Step 1. Define the boundaries and attributes of the study site
In some cases, such as urban forests or national parks, boundaries are straightforward to identify, whereas in others, such as hunting areas, they may be more complex.

Step 2. Definition of population aim
This group primarily includes current and potential visitors to the site, whether for day trips or overnight stays. It is recommended that trips included in the analysis be of similar duration among respondents. Combining single-day and multi-day trips within the same analysis is not advisable (Haab & McConnell, 2002). When multiple recreational purposes exist, similar activities may be grouped to facilitate data collection and analysis.

Step 3. Define the sampling strategy
Sampling can be on-site (in situ), off-site (external), or a combination of both. In on-site sampling, commonly used in single-site models, visitors are surveyed directly at the location. In off-site sampling, respondents are drawn from the general population, which allows for the inclusion of both users and non-users of the site (Parsons, 2003).

Step 4. Conduct the survey
The type of questions will depend on the objectives of the study and the data required. A survey should include:

I. a brief description of the purpose of the study,
II. a detailed description of the site being evaluated,
III. potential problems affecting the location, e.g., lack of services),

IV. a short list of available services (e.g., presence of specific tree species in a forest),,
V. potential effects of environmental policies,
VI. a specific section on trip costs and details, and
VII. una descripción del posible modo de pago (Merlin & Reid, 2017).

Step 5. Calculation of travel and other costs

It is necessary to define which types of costs will be included. These may consist of explicit travel costs (entry fees, transportation, lodging, equipment rental, etc.) and implicit non-monetary costs (such as the opportunity cost of travel time).

It is also important to determine how many people share a vehicle to accurately estimate the cost per person. Equipment costs can be factored in as well, as they increase total trip expenses depending on the type of recreational activity. A widely debated topic is the estimation of the opportunity cost of travel time (Mayer & Woltering, 2018).

Step 6. Model estimation and welfare estimates

La elección del modelo dependerá del objetivo y de los datos disponibles. Se puede optar por una regresión simple del costo de viaje en un único sitio o por modelos más complejos, como los de utilidad aleatoria para múltiples sitios (Mavsar *et al.*, 2013; Riera & Signorello, s. f.).

Case Studies Applying the Travel Cost Method

Economic Assessment of Ecotourism as a Viable Activity for the Sustainable Development of Ecuador's Protected Areas (PAs): Application of the Travel Cost Method in the Cuyabeno Wildlife Production Reserve (RPFC)

In Ecuador's protected areas, the sustained benefits generated by ecotourism are linked to the economic and environmental gains derived from experiencing and appreciating the scenic beauty and recreational opportunities these landscapes provide. Theoretically, these benefits arise from a weak complementarity between private goods and environmental goods.

To quantify these benefits, the study applied the travel cost method in the RPFC to illustrate the economic value of ecotourism in one of Ecuador's most biodiverse protected areas, located in the Amazon basin. Based on the results, the study recommends that the Ecuadorian government adopt environmental policy instruments to regulate and promote this key private sector activity, which contributes to both conservation and the sustainable development of the country's protected areas (Herrera, 2014).

Valoración económica del Complejo Arqueológico de Kuélap, Amazonas, Perú

The objective of the study was to assess the economic and social benefits of the Kuélap Archaeological Complex in the Amazonas region of Peru by estimating the surplus demand for tourist visits. The use value was determined through the individual travel cost method, using a Poisson econometric model.Surveys were conducted with 383 tourists, both national and international. The results showed that the variable travel cost had an expected negative coefficient of -0.07 in the demand for visits, which was statistically significant.

This parameter reflects inelastic demand, indicating that the archaeological remains of Kuélap have few substitutes in the northern Peruvian Amazon. It was further estimated that the welfare gained by each visitor was approximately S/ 15.00 (USD 3.91), and that in 2018 the 110,068 visitors generated a total economic welfare value of S/ 1,651,020.00 (USD 429,972.33). These findings provide a valuable input for formulating public policies aimed at promoting the sustainable development of Peru's natural and cultural heritage areas (Requejo-La Torre *et al.*, 2023).

Environmental Economic Assessment of Ecotourism on Uros Island, Puno, Peru

This case study aimed to evaluate the ecosystem service provided by Uros Island, considering the risk of its total deterioration within 23 years due to severe environmental pollution in Lake Titicaca. The valuation was conducted using the travel cost method, based on the number of annual visits to the island, which forms part of the Lake Titicaca Reserve.A zonal model was applied to identify the regions of origin of the highest tourist inflows, which helped determine spending levels on accommodation, food, transportation, and other categories.

The variables included travel cost, number of visits, visits per capita, population, and income.The model yielded positive results, estimating the island's annual recreational value at S/ 163,836,404.10 (USD 42,667,636.20). Furthermore, the investment project was found to be economically viable, yielding a return of S/ 3,032,630.06 (USD 789,782.69). The study was based on the Environmental Project Assessment Manual by Jesús Collazos Cerrón (2007), which details the application of the travel cost method (Bohorquez, 2020)

Advantages and Limitations of the Travel Cost Methodology

Advantages

It enables the calculation of the recreational value of a specific site and is relatively simple to apply (Özdemiroğlu *et al*., 2006).

Limitations

- It tends to underestimate the recreational value of a site, as it only considers time and money spent on travel, without accounting for other intangible benefits.
- It is not suitable for multi-purpose trips, where visiting the site is not the primary purpose of the journey.
- It has limitations in low-income contexts, where a large share of the population cannot afford recreational travel, reducing the representativeness of the data (Özdemiroğlu *et al.*, 2006)

Recommended References for Further Information

- Parsons, G. (2003). Capítulo 9: The Travel Cost Model (páginas 269 a 324). Parte del libro A Primer on Non-market valuation.
- Mayer, M., & Woltering, M. (2018). Assessing and valuing the recreational ecosystem services of Germany's national parks using travel cost models. *Ecosystem Services*, 31, 371–386.

Deliberative Economic Valuation Methodology

Deliberative economic valuation methods integrate the economic valuation of ecosyyem services with participatory processes. Their purpose is to involve stakeholders and the broader community in decision-making related to the management and conservation of ecosystem (Kelemen & Gómez, 2010)

These approaches recognize that the valuation of ecosystem services is not only a technical matter but also a social and political one. They allow individuals to express their preferences and values regarding ecosystem services, emphasizing that decisions should be grounded in democratic and participatory processes. (*ibid.)*.

Steps for Applying the Deliberative Economic Valuation Methodology

This methodology is not unique or standardized. It is a conceptual framework that brings together a range of applications, tools and techniques aimed at monetizing sociocultural values and evaluating changes in ecosystem service flows that directly affect people's quality of life. Consequently, there is no universally recognized structure for its application. However, the following step by step process is recommended, based on insights from multiple studies: (Kelemen & Saarikoski, 2015; Fish *et al*., 2011).

Step 1. Workshop with stakeholders' representatives

This stage focuses on identifying, gathering, and systematizing information, as well as conceptualizing and developing system models that link the economy, environment, and society.

1. Pose initial questions to explore perceptions of ecosystem benefits, preferences, and issues related to the proposed policy or project.
2. Identify and prioritize key variables within the socio-ecological system.
3. Develop conceptual models of participatory systems.
4. Facilitate discussions to connect socio-ecological benefits and systems with ecosytem services.
5. Conduct practical deliberation exercises.
6. Gather feedback from stakeholders and assess learning outcomes.

Step 2. Workshop with community representatives

The purpose of this step is to democratize the process of valuing ecosystem services. A participatory conceptual model is applied, followed by the use of economic valuation methods, most commonly contingent valuation. The workshop is facilitated by the technical team, with support from community leaders whenever possible.

1. Introduce the topic of study, focusing on its potential impact on community well-being (project or policy), presented by the researcher.
2. Administer questionnaires to identify key values and perceived benefits .
3. Conduct a structured, open, and equitable discussion on values and benefits.
4. Use participatory conceptual models.
5. Facilitate discussions to connect values and benefits with ecosystem services.
6. Apply valuation methods such as contingent valuation, which measure the amount an individual believes they should pay or accept.
7. Apply contingent valuation in a deliberative group setting, where participants express the value, they believe society should pay or accept collectively.
8. Conclude with feedback from community representatives and an evaluation of learning outcomes

Case Studies Applying the Deliberative Economic Valuation Methodology

Kenya Valuing the Subsistence Use of Forest Products from the Oldonyo Orok Forest, Kenya

The Oldonyo Orok Forest, covering approximately 12,000 hectares, is located along the border between Kenya and Tanzania. The local community depends heavily on forest resources for food, fuel, medicine, fodder, and shelter.

The assessment process followed three stages. In order to identify the relative importance of different forest products, a classification exercise was carried out using illustrated cards depicting different activities carried out in the forest. Participants ranked the cards according to their perceived importance and explained why, when, how, and by whom each activity was performed.

Because information was collected through image-based selection rather than direct questioning or observation, this approach effectively revealed key themes and patterns of resource use.

The study found that most households extensively used the forest for fuel, shelter, medicine, and food. Forage and water together accounted for about half of the total perceived value. On average, forest-derived livelihoods were valued at approximately USD 100 per inhabitant per year (in 1995), equivalent to one-third of the value of subsistence livestock production.

Moreover, research showed that the forest serves as the main refuge and source of livelihood.

for more than 1,000 households in the surrounding region (Emerton, 1996)

Deliberative Monetary Valuation: Preferences and Participation

In the field of environmental assessment and decision-making, there is growing interest in the use of deliberative methods. Deliberation is expected to foster collective decisions guided by preferences that are more oriented toward the common good.

This study draws on data from a Deliberative Monetary Valuation (DMV) exercise conducted in Colombia, with the aim of examining: i) the influence of deliberation on participants' preferences, and ii) the relationship between individuals' socioeconomic conditions and their level of participation in the deliberative process.

The evidence suggests that: i) deliberation generates preferences more closely aligned with social concerns, and ii) inequalities in social status and educational level are associated with higher levels of participation in deliberative processes.

The findings indicate that, although deliberative processes can transform preferences and incorporate dimensions such as equity into decision-making, they may also create exclusionary dynamics if the influence of certain social groups becomes dominant. For further methodological details, see Vargas (2015)

Recommended References for Further Information

- Kelemen E, Gómez-Baggethun E. *Participatory methods for valuing ecosystem services*. Budapest: Institute of Environmental Studies, Eötvös Loránd University; 2010.
- Kelemen E, Saarikoski H. *Method factsheet: Deliberative valuation*. OpenNESS Project Deliverable; 2015.

Contingent Valuation Methodology

This methodology uses questionnaires that ask respondents to express their preferences in monetary terms through willingness to pay (WTP) or willingness to accept (WTA) questions. In other words, it measures how much individuals would be willing to pay for specific changes in ecosytem services. This approach allows for the evaluation of scenarios that have not yet occurred, making it possible to analyze hypothetical policies or "future states of the ecosystem" (UNEP, 2014)

The design and implementation of questionnaires require specific strategies to ensure the statistical representativeness of the samples, as well as prior testing of the instrument to confirm that the valuation exercise is appropriate for the characteristics of the target population (*ibid.*). Primary data collection depends on access to the communities within the area of influence and on adequate literacy levels to ensure that responses can be accurately recorded (*ibid.*).

It is also worth noting that this methodology can be applied to the valuation of intangible cultural services, such as cultural heritage or the protection of natural habitats, including spiritual and legacy values associated with ecosyyem services (*ibid.*).

Pasos para aplicar la metodología de valoración contingente

Step1. Define the objectives of the assessment

Identify the ecosytem services to be valued and provide clear justification for why the valuation is necessary..

Step 2. Select the type of survey

Decide on the application format (e.g., in-person, online, by telephone, or other methods).

Step 3. Design the Questionnaire (Kyophilavong, 2011)

Questionnaire design is one of the most critical stages of the process. Three key aspects must be taken into account:

- **Respondent's capacity**
  The questionnaire should be simple and easy to understand, as participants may not recall or fully comprehend technical details.
- **Complexity of the questionnaire** should be tailored to the local context and avoid overly complex structures that hinder understanding.
- **Time and cost.** In contexts with limited resources, it is advisable to avoid lengthy or expensive questionnaires.

El diseño del cuestionario consta de tres procesos:

1. **Discussion with key informants.** Engage community members, local authorities, and technical experts, and review relevant literature to design a questionnaire that reflects local ecosystem benefits.
2. **Pre-test.** Administer the questionnaire to a small sample (10 to 20 people) to identify potential issues. Evaluate the duration, language, and clarity of the questions.
3. **Review of the questionnaire.** Adjust the instrument based on pre-test results. If necessary, conduct a second test to validate the revisions

Step 4. Define the target population (Respondents).

Identify individuals who could benefit directly or indirectly from the ecosytem services being assessed. It is recommended to use stratified random sampling, following three main steps

- **Divide households into urban and rural categories** to capture differences in perceived benefits.
- **Classify households as high-, middle-, or low-income,** with support from community leaders to ensure accurate categorization.
- **Determine the sample size** according to the available time, budget, and resources.

Paso 5. Survey preparation (Kyophilavong, 2011).

This step includes the following activities:

- **Formation of the survey team.** Ensure that interviewers understand the questionnaire and have a clear manual and guidelines.
- **Selecting the survey method.** Face-to-face interviews are recommended in rural areas with low levels of education. In some cases, residents can be invited to a designated meeting place.
- **Presupuesto.** Establish a realistic budget that includes a contingency margin for unforeseen expenses
- **Logistics.** Prepare questionnaires, coordinate transportation, and maintain communication with local authorities. It is advisable to use a checklist to confirm that all preparations are complete.

Step 6. Econometric modeling of survey responses

Prepare the databases and apply the appropriate econometric models to analyze the survey results

Step 7. Statistical analysis

Define the supply and probability functions and estimate the parameters using probabilistic models, depending on the type of contingent valuation applied.

Case Studies Applying the Contingent Valuation Methodology

Economic Valuation of Water Ecosystem Services: A Case Study of the Water Supply System of the City of Tulcán

The study is based on an economic assessment of the hydrological environmental services provided by the Tufiño moorland. The aim is to promote these services as a financing instrument to support the sustainability of the city of Tulcán's current drinking water supply. To that purpose, a statistical model was developed to estimate willingness to pay (WTP), based on a survey of 500 respondents. Users' WTP was quantified using an ordinary least squares model.

The results indicated that the average willingness to pay was USD 2.76 per household per month. Considering that 16,069 households in Tulcán receive water through the public network, the total estimated monthly revenue was USD 44,350. This amount exceeds the costs associated with the capture and restoration of the city's water resources (Paspuel, 2009).

Valoración económica de los ecosistemas del Área Natural Protegida "Vilacota Maure", Tacna-Perú

Este estudio utilizó la metodología de valoración contingente para determinar la disposición a pagar (DAP) de los ciudadanos del área metropolitana de Tacna, Perú, con miras a la constitución de un fondo financiero que permita el diseño e implementación de actividades de conservación de la biodiversidad y la mejora de los servicios ambientales del Área de Conservación Regional Vilacota Maure.

WTP was estimated using a LOGIT probabilistic model, based on the theoretical framework of economic utility proposed by Hanemann (1984). The results indicate that both the income variable and a set of ecosystem service appreciation variables were significant in explaining WTP.

The estimated median WTP was USD 3.40 per household per year. It was further estimated that residents of Tacna could contribute approximately USD 95,281.20 annually, representing a 66% increase over the budget typically allocated by the Tacna Regional Government for managing this protected natural area.

Despite the adverse economic context caused by the 2020 public health crisis, the results highlight the importance of economic valuation for designing and implementing conservation and ecosystem enhancement measures, and they underscore that the regional budget is insufficient to ensure adequate conservation (Albarracin & Alarcón, 2021).

Economic valuation of the ecosystem services of the Coata River basin, Puno, Peru

The objective of this study was to estimate the economic value of the ecosystem services provided by the Coata River basin, assess the willingness to pay (WTP) for their improvement and identify the socioeconomic variables that influence this willingness. The contingent valuation method was applied using a binomial LOGIT econometric model, based on survey data collected from a sample of 369 households in the districts of Caracoto, Coata, Huata and Capachica.

The survey was designed, reviewed and implemented in accordance with the study objectives, using primary data collection techniques. The information obtained was subsequently systematized and subjected to statistical analysis using SPSS 25.0 and Stata 16.0.

The estimated mean WTP was S/ 4.88 per household per month (USD 1.27), demonstrating a positive willingness to pay among households in the basin. The analysis indicated that WTP is influenced by variables such as age (2.77%), education level (3.1%), frequency of use of ecosystem services (2.3%) and distance to the river (2.3%).

The results differ from previous studies that reported a positive association between education level and WTP. In this case, although education was statistically significant, the chi square test showed that distance to the river and the hypothetical price were key determinants in explaining WTP (Quispe *et al.*, 2021).

Advantages and limitations of the contingent valuation method

Advantages

Contingent valuation allows a high degree of flexibility in the design of questions, including the evaluation of scenarios that have not yet occurred. (Bateman & Turner, 1993).

Limitations

Respondents' valuations can be influenced by their prior knowledge and by the information provided in the questionnaire. It should also be noted that survey responses are based on hypothetical behavior, which may differ from actual behavior (Bateman & Turner, 1993)

Recommended reference for further information

- Whitehead, J. C. (2006). Capítulo 3: A Practitioner's Primer on the Contingent Valuation Method. Parte del libro *Handbook on Contingent Valuation*, de A. Alberini & J. Kahn.
- Bouma, J. A., & Van Beukering, P. (2015). *Ecosystem Services. from Concept to Practice.* Cambridge University Press.
- Questionnaire design and data analysis: Bateman, I., Carson, R., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones, M., Loomen, G., Mourato, S., Özdemiroğlu, E., Pearce, D., & Elgar, E. (2002). *Economic Valuation with Stated Preference Techniques: A Manual.* Edward Elgar Publishing.
- Managing uncertainty in contingent valuation methodology application questionnaires Schkade, D., & Payne, J. (1994). *How People Respond to Contingent Valuation Questions: A Verbal Protocol Analysis of Willingness to Pay for an Environmental Regulation.* Department of Management, University of Texas. Duke University, Durham, North Carolina.

Avoided Cost Valuation Methodology

The avoided cost approach estimates the economic value of ecosystem services by calculating the expenses that would be incurred if those services were unavailable. It assumes that ecosystem services provide essential benefits that, in their absence, would require additional investment or expenditures to replace. (Bouma & Pieter, 2015)

For instance, if a wetland protects nearby properties from flooding, the value of this service can be estimated based on the damage avoided when flooding does not occur, or on the expenditures that property owners would need to make to safeguard their assets. (ibid.).

Steps for Applying the Avoided Cost Valuation Methodology

Step 1. Identify the environmental service(s) provided. Specify the relevant services, how they function, who benefits from them, and their scale or magnitude. In the case of flood protection, this requires estimating the frequency and intensity of flooding events and their potential impact on property

Step 2. Estimate the potential physical damage that would occur without the environmental service, either annually or over a defined period.

Step 3. Determine the economic value of the avoided damage, or alternatively, the costs that affected populations would be willing to incur to prevent such damage.

Case Studies Applying the Avoided Cost Valuation Methodology

Estimating Environmental Costs Associated with Drinking Water Quality in Risaralda, Colombia

A study developed a valuation model to quantify the environmental costs associated with drinking water quality in municipalities in the department of Risaralda. The analysis found that contamination by fecal coliforms is a significant factor, although not the only one, in explaining morbidity from acute diarrheal disease (ADD). It also showed that inadequate treatment and disinfection systems negatively affect public health, particularly in areas with unmet basic needs (UBN)

Based on the model, a 1% increase in fecal coliform contamination was estimated to generate environmental costs of approximately 100 million Colombian pesos (USD 24,374). Furthermore, the total environmental costs associated with ADD in the department were estimated at approximately 6.9 billion pesos (USD 1,681,777), considered a lower-bound estimate of the actual environmental costs (Ramírez *et al*., 2010)

Assessment of Avoided Costs in the Adult Population Resulting from Improved Water Consumption in the Parish of San Isidro, Manabí Province (2018–2019)

This study examines the relationship between water quality and the health of residents in the rural parish of San Isidro, located in the province of Manabí. Data collection revealed that 60% of respondents sourced their daily water from wells, rivers, or springs, and that the piped water supply was not fully suitable for human consumption. The water source and its treatment were identified as significant variables associated with the development of liver and dermatological diseases, according to survey results.

Structured interviews with medical specialists were used to estimate the treatment costs associated with these diseases. Based on this information, the study calculated the potential costs that could be avoided through the implementation of technologies to improve water quality. The estimated avoided cost per person was USD 4,226 for liver diseases and USD 5,370.33 for dermatological conditions (Flores, 2019)

Recommended reference for further information

- Bouma, J. A., & Van Beukering, P. (2015). *Ecosystem Services. from Concept to Practice.* Cambridge University Press.

Cost–Benefit Analysis (CBA) Valuation Methodology

Cost–benefit analysis is one of the most widely used methodologies in environmental policy, as it allows for the assessment of the advantages and disadvantages of a given alternative relative to others (Azqueta *et al*., 2007).

CBA provides a systematic approach for comparing the economic costs and benefits of different policies, programs, and projects. In theory, the process is straightforward: all expected costs and benefits of the proposed project or policy are identified, quantified, aggregated, and compared (TEEB, 2010).

Steps for Applying the Cost–Benefit Analysis (CBA) Valuation Methodology

Step 1. Identify relevant alternatives

CBA is a comparative tool designed to determine the most suitable option among several alternatives. It is therefore essential to clearly define the objective and scope of the study and to specify all alternatives to be evaluated.

Step 2. Establish a reference scenario

The contribution of each alternative toward achieving the stated objective must be assessed against what would occur in the absence of intervention (baseline scenario). For example, if a protected area were not created, the land might instead be used for agricultural purposes. The intervention scenario and the non-intervention scenario must be compared consistently and in relation to the same objective.

Step 3. Identify costs and benefits

All relevant elements of each alternative that either support or hinder achievement of the objective must be identified. This step also includes determining the groups and individuals who are directly or indirectly affected.

Step 4. Value costs and benefits

Once identified, costs and benefits must be expressed in a common unit of measurement, typically monetary terms, to enable direct comparison between the components of each alternative.

Step 5. Discount future costs and benefits

Because present and future values are not equivalent, a discount rate must be applied to determine the present value of future cost and benefit streams. This ensures that all impacts are expressed in current terms.

Step 6. Address risk and uncertainty

Future projections are inherently uncertain. It is therefore important to incorporate uncertainty into the analysis and pay particular attention to alternatives characterized by higher levels of risk.

Step 7. Apply selection criteria

Profitability indicators are then applied to support decision-making. Common metrics include net present value (NPV), cost–benefit ratio (CBR), and internal rate of return (IRR), among others.

Case Studies Applying the Cost–Benefit Analysis (CBA) Valuation Methodology

Cost–Benefit Assessment of Comprehensive Solid Waste Management in Residential Complexes in Cali

In Cali, Colombia, the environmental policy of Integrated Solid Waste Management has been promoted. This study quantified the economic costs and benefits of implementing a comprehensive solid waste management plan in residential complexes, using social cost–benefit analysis as the evaluation tool.

The analysis estimated the impact of recycling 100% of recyclable solid waste, considering effects on natural resources and job creation. The benefit–cost (B/C) ratio indicated that the project is economically attractive, with a ratio of 4.1. This means that for every Colombian peso invested, an estimated return of 4.1 pesos is generated (Osorio, 2016).

REDD+ Cost–Benefit Analysis of Non-Conventional Renewable Energy in Colombia

This study contributes to public policy discussions on the development and adoption of non-conventional renewable energy in Colombia. Its objective was to estimate the economic and social costs of electricity generation using traditional technologies (thermal and hydroelectric plants) and non-conventional renewable sources (run-of-river hydroelectric, wind, geothermal, and biomass cogeneration).

The CBA was conducted from both private and social perspectives, assessing several scenarios:

1. with and without long-term financing,
2. with and without internalization of externalities,
3. with and without reliability charges,
4. with different discount rates (3%, 6%, 9%), and
5. according to the levelized cost of energy (LCOE) of thermal plants, based on site characteristics.

Net present value (NPV) served as the key performance indicator. Results showed that hydroelectric plants have the highest NPV, although they require long investment periods (approximately ten years), despite low operating and maintenance costs. By contrast, thermoelectric plants have shorter construction periods, allowing benefits to materialize more quickly. The study concludes that lower discount rates increase NPV, although the magnitude of the effect varies depending on the energy source evaluated (García et al., 2013)

Advantages and Limitations of the Cost–Benefit Analysis (CBA) Methodology

Advantages

- It is grounded in a comprehensive yet straightforward decision-making framework, which facilitates identifying alternatives whose benefits exceed their costs.
- It enables systematic comparison of different projects using standardized indicators such as net present value (NPV) and internal rate of return (IRR).
- It employs monetary units as a common metric for all costs and benefits, allowing consistent comparison across policy, program, or project alternatives.

Limitations

- Assigning monetary values to certain costs and benefits can be contentious, particularly for aspects such as ecosystem resilience or biodiversity loss.
- CBA outcomes are sensitive to the selected discount rate, which can significantly influence the results and final conclusions.
- In environmental and climate-related contexts, CBA may overlook important qualitative dimensions by focusing primarily on monetary measures and failing to incorporate qualitative criteria.
- CBA does not necessarily incorporate participatory processes, increasing the risk of bias by failing to capture diverse social perceptions and values.

Recommended reference for further information

- Azqueta, D., Alviar, M., Domínguez, L., & O'Ryan, R. (2007). *Introducción a la economía ambiental* (2.ª ed.). McGraw-Hill.

Section 5

Practical Application: Case Studies on the Economic Valuation of Ecosystem Services

The objective of this section is to guide the selection of the most appropriate method, considering the particular characteristics of each approach. Case studies have shown that the selection of an economic valuation method depends largely on factors such as the level of stakeholder involvement, the incorporation of local knowledge, the ease of communicating results and the usefulness of the study for decision making. Likewise, pragmatic considerations, including data availability, financial and technical resources and the prior experience of the evaluation team, are key determinants in this choice (Harrison, 2018). For a more precise selection of a method, it is important to consider the territorial and ecological context of the country. Ecuador is divided into four natural geographic regions: Coast, Sierra, Amazon and Galapagos. At the ecosystem level, the country is home to 91 ecosystem types: 65 forest ecosystems, 14 herbaceous ecosystems and 12 shrub ecosystems (INABIO, n.d.).

The development of this guide involved joint work with the technical departments of the Ministry of the Environment and Water (MAE) to identify current and potential cases of economic valuation of ecosystem services that they face, or could face, in the exercise of their functions.
This collaboration made it possible to address a range of technical and territorial needs that guide the practical use of this document in planning, policy formulation, decision making and the implementation of financial mechanisms.

Process for Identifying Ecosystem Service Valuation Cases for the MAE and Prioritizing Valuation Methods

Diagram 3 presents the methodological process used to identify and classify y categorizar los casos de valoración económica de servicios ambientales

and classify ecosystem service valuation cases submitted by the various technical directorates of the MAE. Based on this process, criteria were defined to link each case with the most appropriate valuation methodology(ies), considering technical relevance, operational feasibility, and usefulness for decision-making in environmental and sectoral policy contexts.

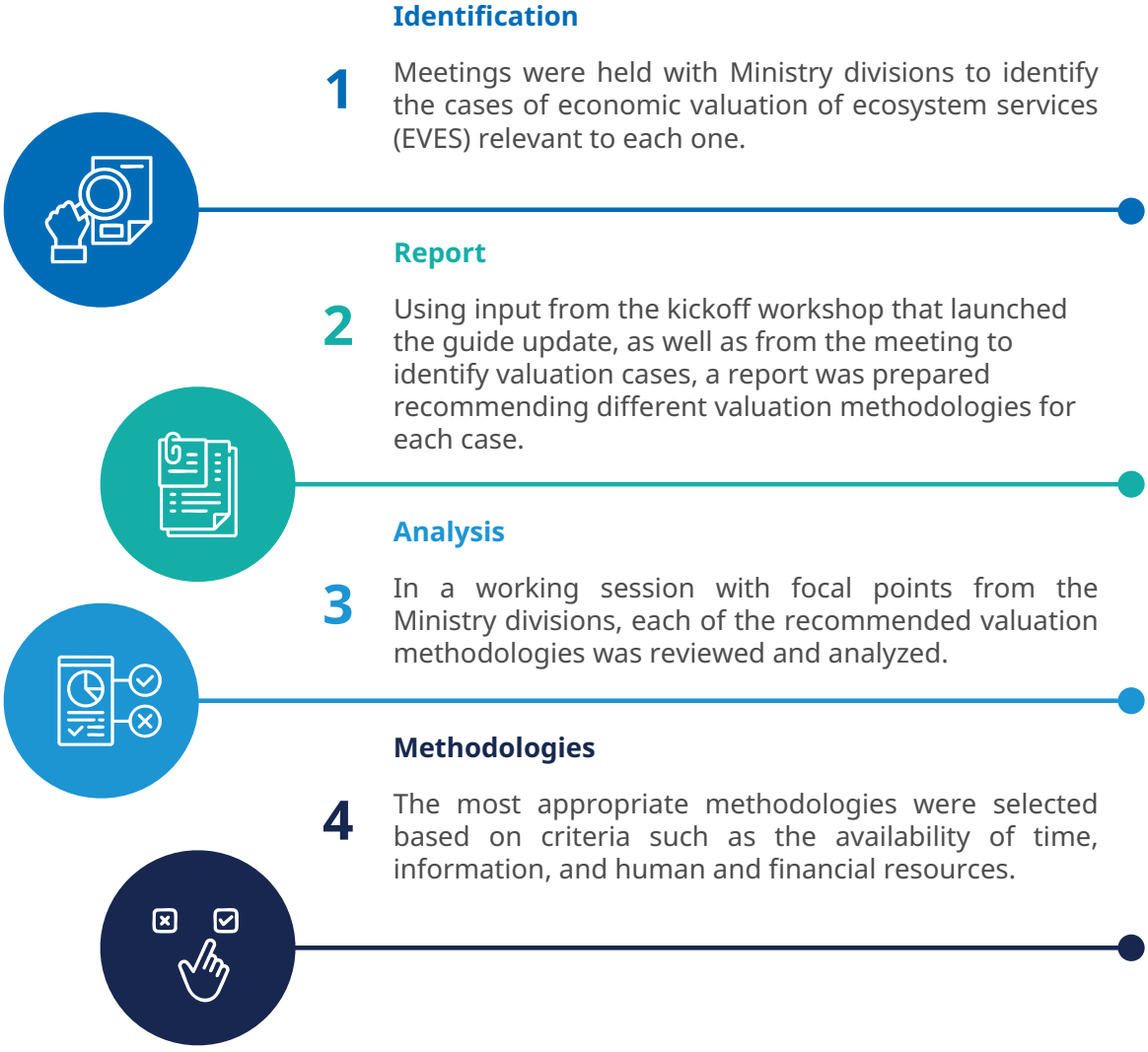


Diagram 3. Process of identifying valuation methodologies.

Based on this collaborative work process, and without prejudice to the possibility of new cases being identified in the future, the following cases of economic valuation of ecosystem services were defined.

Diagram 4 presents a classification of these cases according to the Ministry unit that proposed them.

*Ministry of Environment, Water and Ecological Transition**

Vice Ministry of Environment

Undersecretariat for Environmental Quality

Environmental and Social Remediation Program (PRAS)

Assessment of environmental damage or pollution liabilities.

Inclusive Circular Economy and Solid Waste Management Project (GRECI)

Economic valuation of:

i. environmental damage and restoration associated with open dumpsites.
i. the determination of Integrated Solid Waste Management (ISWM) tariff, considering environmental damage and restoration.
ii. environmental damage and restoration associated with sanitary landfills and emergency disposal cells.

Protected Areas Directorate

Economic valuation of:

i. scenic value of protected areas (PAs) for tourism and recreation.
ii. services provided within PAs for pipelines, electricity infrastructure, and telecommunications.
iii. (continues beyond the visible section)

Undersecretariat for Natural Heritage

Biodiversity Directorate

Economic valuation of:

i. genetic resources.
ii. wildlife species, especially pollinators.
iii. landscape value for tourism.
iv. loss of biodiversity species.
v. provisioning and regulating ecosystem services, such as food, water, climate, air, and soil.

Forests Directorate

Economic valuation of:

i. activities that affect forest heritage (deforestation, forest degradation, wildfires, land-cover change and use within the National Forest Heritage).
ii. removal of native vegetation cover within the forest heritage due to the execution of projects, works or activities subject to environmental regularization.
iii. infractions related to the loss of different ecosystems within the forest heritage.
iv. spread of pests in forests and páramo ecosystems.
v. different uses of biodiversity.
vi. ecosystem services for their incorporation into life plans and comprehensive forest and protective-vegetation management plans.
vii. ecosystem services related to land tenure and legalization processes for individual and collective properties located within forests, protective vegetation, and protected areas.
viii. loss of forest species.

National Landscape Restoration Project

i. Return rate of restoration as an incentive
ii. Valuation of degraded areas for restoration
iii. Economic valuation of restoration

Vice Ministry of Water

Undersecretariat for Water Resources

Economic valuation of:

i. ecosystem services provided by water resources (surface water and groundwater across all aquifer systems).
ii. water resources in protection and water–food security areas, and support for establishing a fair raw-water tariff.
iii. water-related ecosystem services for the integrated management and governance of water resources.

Socio Bosque II Project (PSBII)

Economic valuation of:

i. forest conservation through the PSBII.
ii. the carbon footprint and assessment of the potential increase in incentives under the forest conservation agreements signed within the framework of the PSBII.

Diagrama 4. Cases of economic valuation of ecosystem services identified by MAE agencies.

*The update of the EVES Guide began in February 2023, when the Ministry of Environment, Water and Ecological Transition (MAATE) was still in operation. Therefore, Diagram 4 reflects the organizational and functional structure in force at that time for MAATE.

Decision Tree for Selecting Economic Valuation Methods for Ecosystem Services

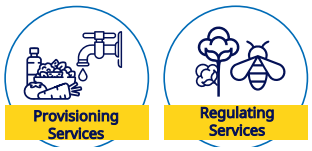
Based on the information collected in the previous section, decision trees were developed around three major themes: (i) natural heritage (forests, biodiversity, landscape restoration), (ii) water resources, and (iii) environmental damage.

Decision Tress for Ecosystem Services Associated with Natural Heritage

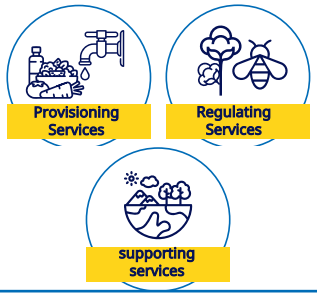
The development of this decision tree takes into consideration different segments associated with natural heritage, such as forests, biodiversity, protected areas, conservation, and ecological restoration. These segments help guide the selection of the appropriate methodology based on the type of ecosystem service being assessed and the corresponding management objective.

Table 2 presents the types of ecosystem services used in economic valuation cases associated with natural heritage.[3]

Table 2. Types of Ecosystem Services and Examples of Economic Valuation Cases Associated with Natural Heritage

Segment	Type of ecosystem service	Examples of economic valuation case
Biodiversity Segment		Wildlife species (e.g., pollinators)
		Genetic resources
		Landscape for tourism

[3] To review the valuation cases in detail, please refer to Diagram 4 in the section of the Undersecretariat of Natural Heritage.

Segment	Type of ecosystem service	Examples of economics valuation case
Biodiversity Segment		Economic valuation of the raw water tariff
		Provision and regulation of ecosystem services (e.g., food, water, climate regulation, air quality, soil functions)
		Loss of biodiversity and species
		Agricultural uses and exploitation of biodiversity
Forest Segment		National Forestry Activities that are harmful to forest heritage, such as deforestation, forest degradation, fires, and changes in land cover and land use within the National Forest Heritage.
		Removal of native vegetation cover within the National Forest Heritage due to the execution of projects, works, or activities subject to environmental regulation.
		Loss of ecosystems within the National Forest Heritage.

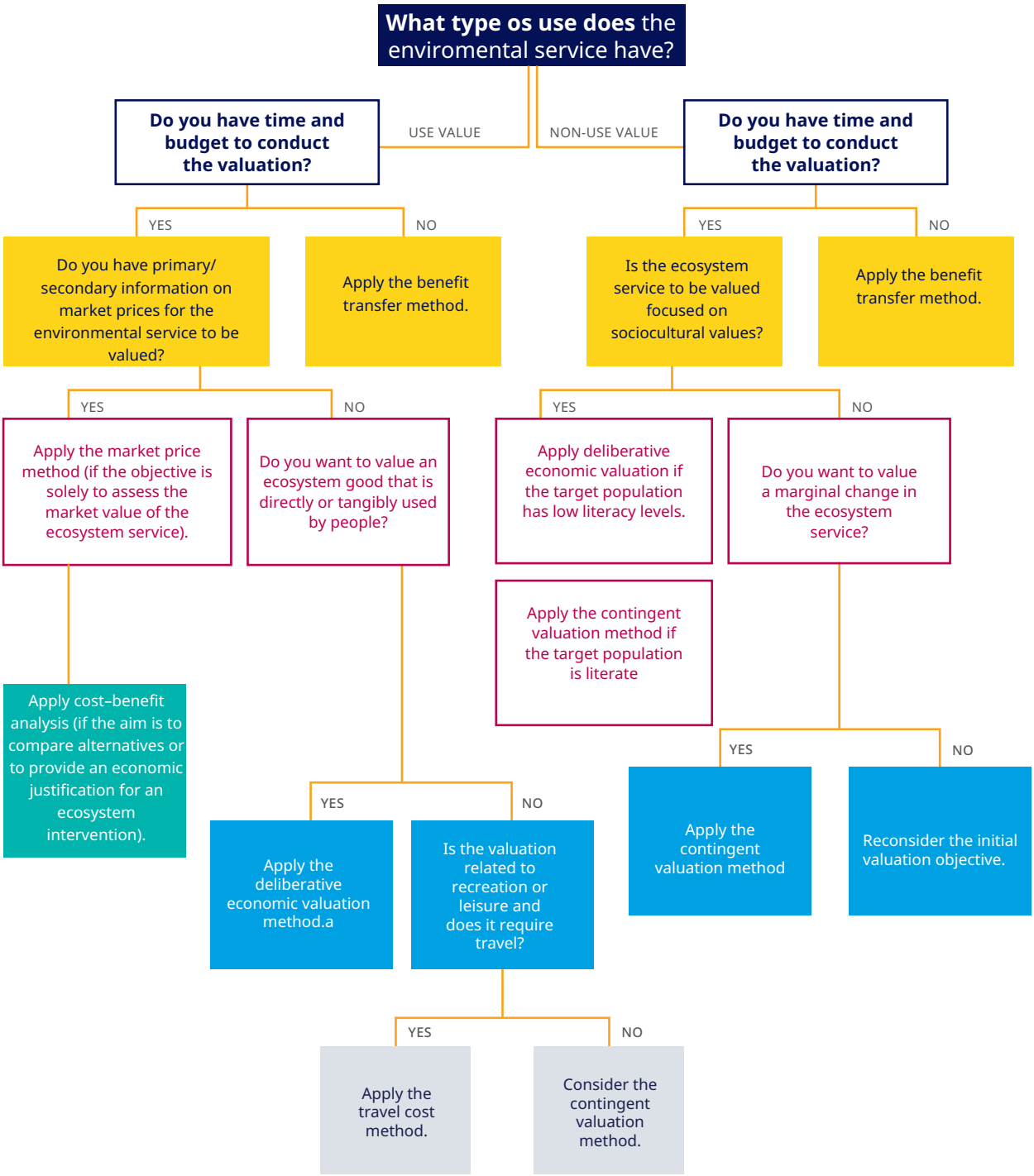
Segment	Type of ecosystem service	Examples of economic valuation cases
Forest Segment		Spread of pests in forests and moorlands
		Land tenure processes and the legalization of individual and collective properties within protective forests, vegetation areas, and protected areas.
		Loss of forest species
		Forest conservation through monetary incentives (e.g., Socio Bosque Project)
Protected Areas Segment		Scenic beauty of protected areas (PA) for tourism
		Services provided within AP for oil pipelines, electric transmission lines, telecommunications

Segment	Type of ecosystem service	Examples of economic valuation cases
Restoration Segment		Return on investment of restoration as an incentive
		Restoration of degraded areas by ecosystem type

The decision trees corresponding to the segments identified in the table are presented below. Table 2 covers Biodiversity, Forests, Protected Areas, and Restoration.

These decision trees guide the selection of economic valuation methodologies according to the characteristics of the ecosystem service and the ecosystem management objective in each case.

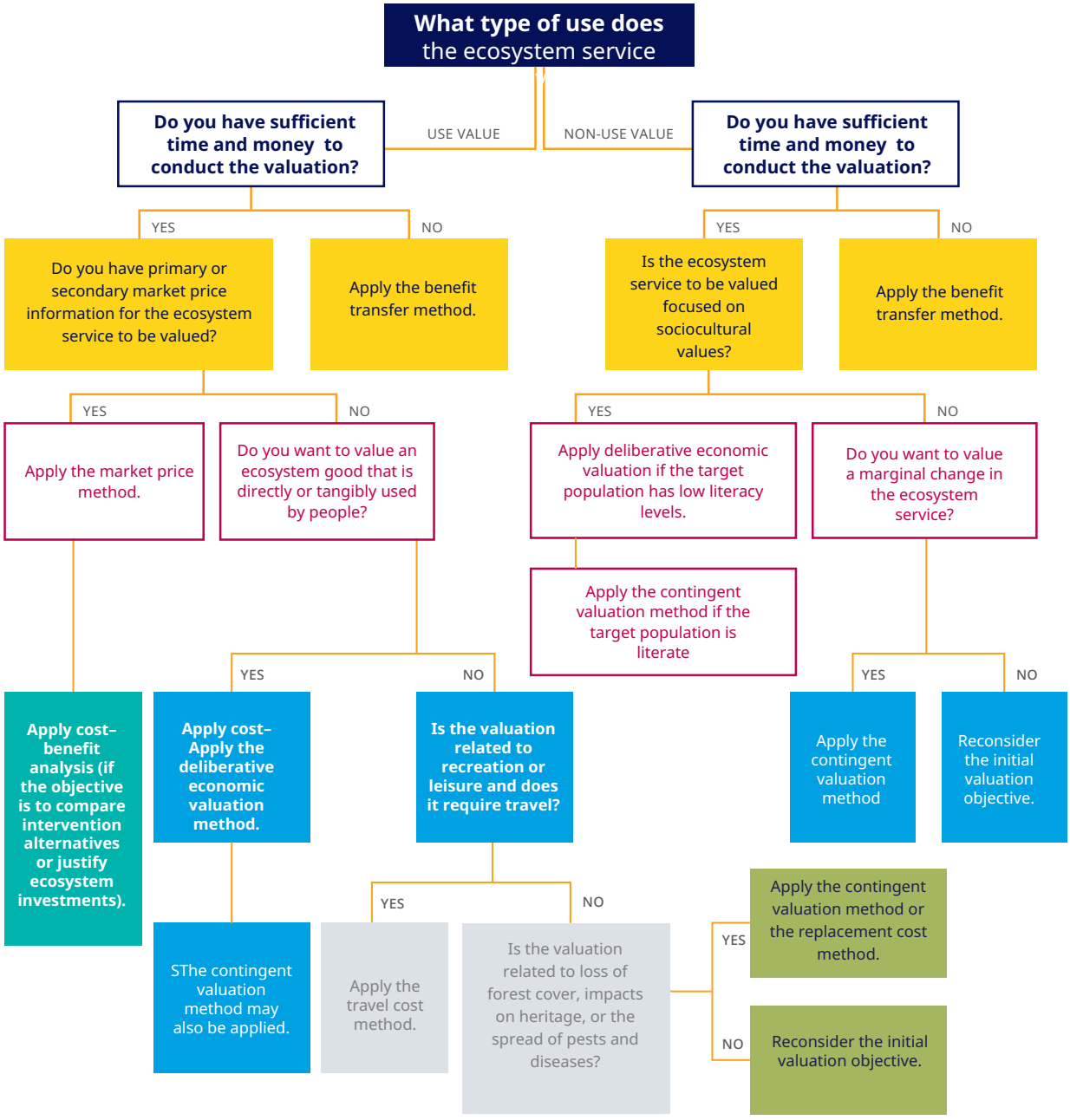
BIODIVERSITY SEGMENT



Decision Tree 1. Biodiversity Segment[4]

[4] For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the existence or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their continued existence. The challenge with this type of value is that it is often difficult to measure, which may lead to an underestimation of these services in economic valuation processes (Moreno *et al.*, 2020).

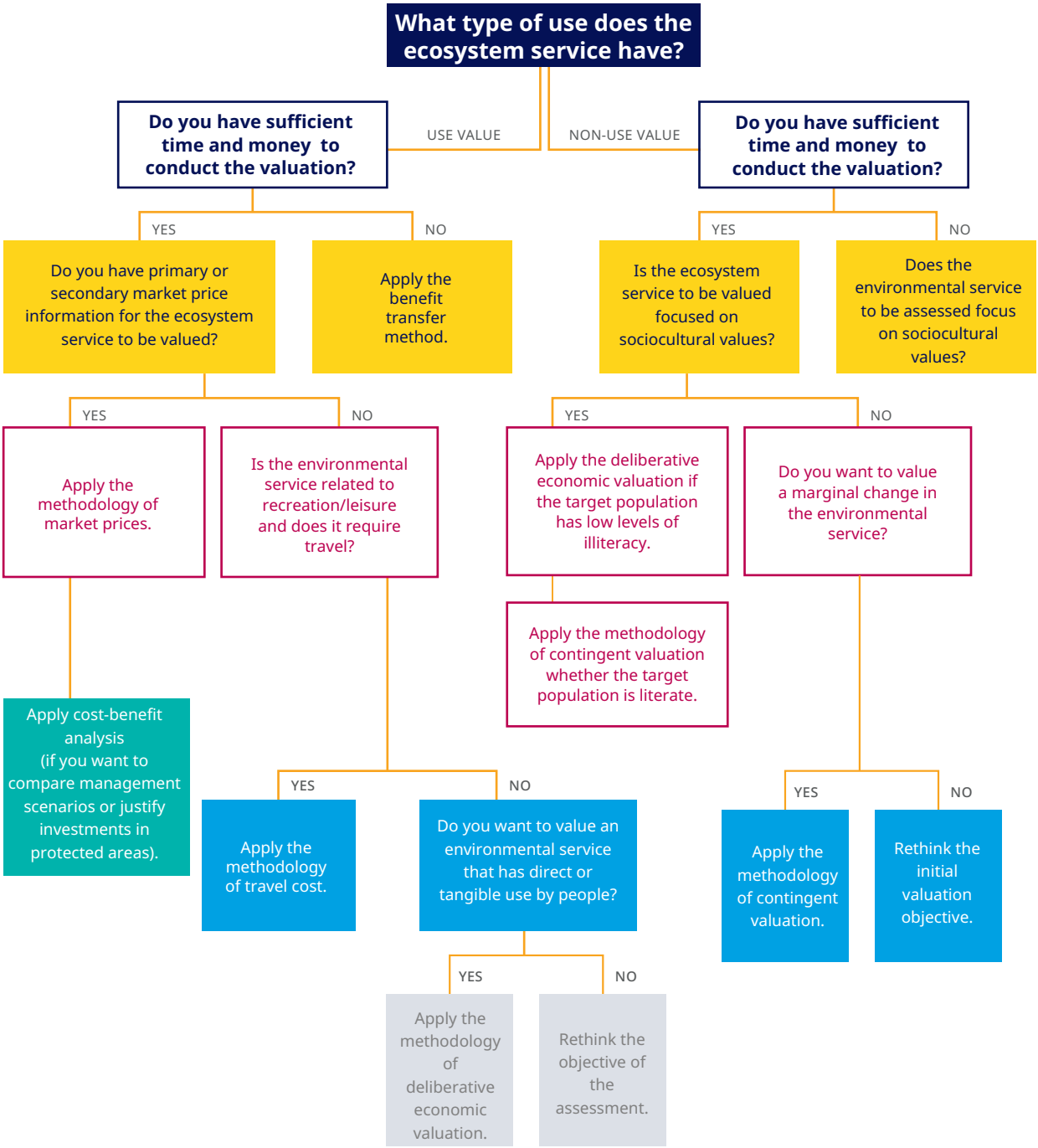
FOREST SEGMENT



Decision Tree 2. Forest Segment[5]

[5]For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the existence or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their continued existence. The challenge with this type of value is that it is often difficult to measure, which may lead to the underestimation of these services in economic valuation processes (Moreno *et al.*, 2020).

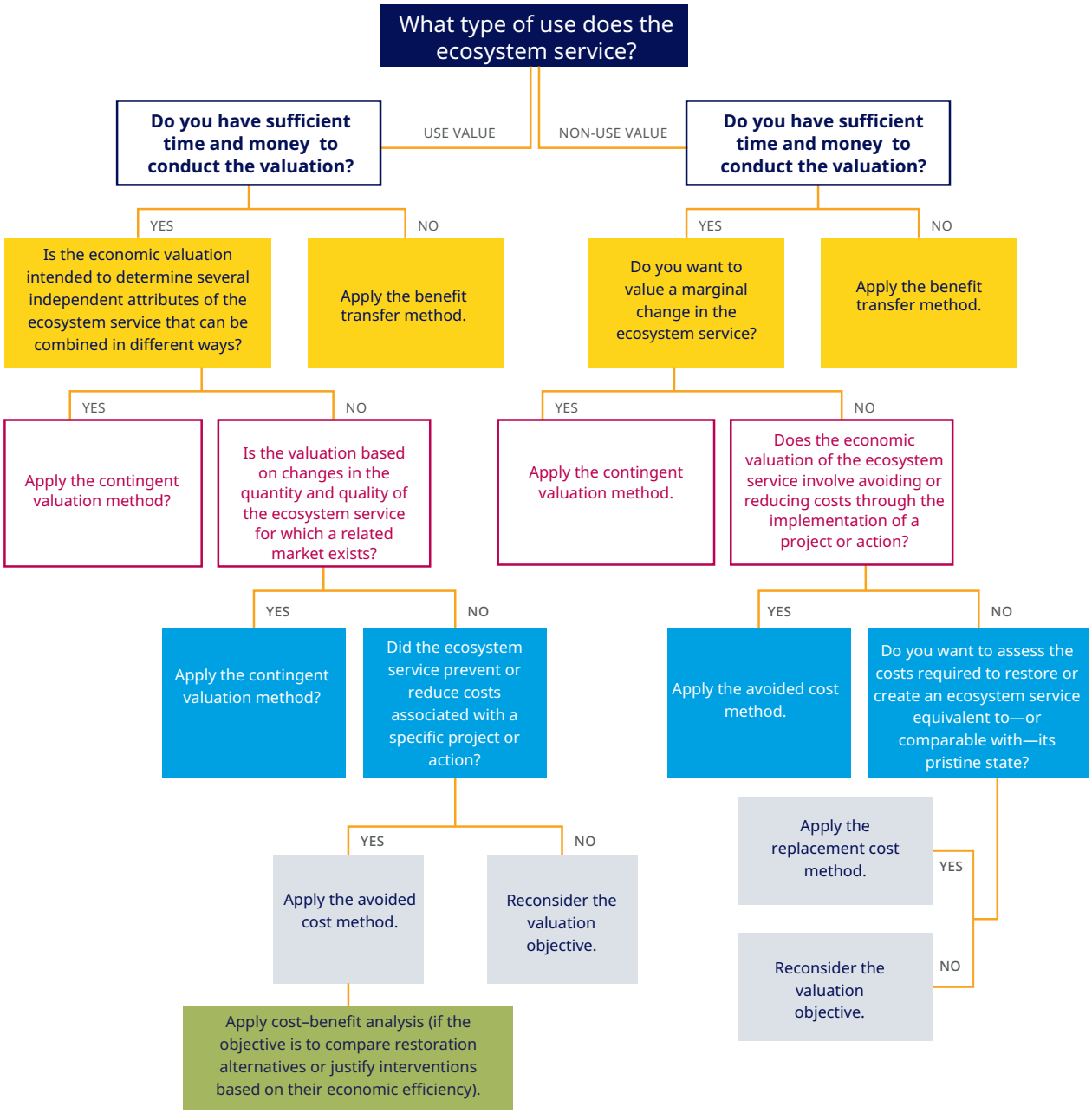
PROTECTED AREAS SEGMENT



Decision Tree 3. Protected Areas Segment[6]

[6] For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the existence or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their continued existence. The challenge with this type of value is that it is often difficult to measure, which may lead to the underestimation of these services in economic valuation processes (Moreno *et al.*, 2020).

RESTORATION SEGMENT



Decision Tree 4. Restoration Segment[7]

[7]For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the existence or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their continued existence. The challenge with this type of value is that it is often difficult to measure, which may lead to the underestimation of these services in economic valuation processes (Moreno *et al*., 2020).

Decision Tree for Ecosystem Services Associated with Water Resources

The decision tree for this sector covers the Water segment. **Table 3** presents the types of ecosystem services identified in ecosystem-service valuation cases associated with water resources.[8]

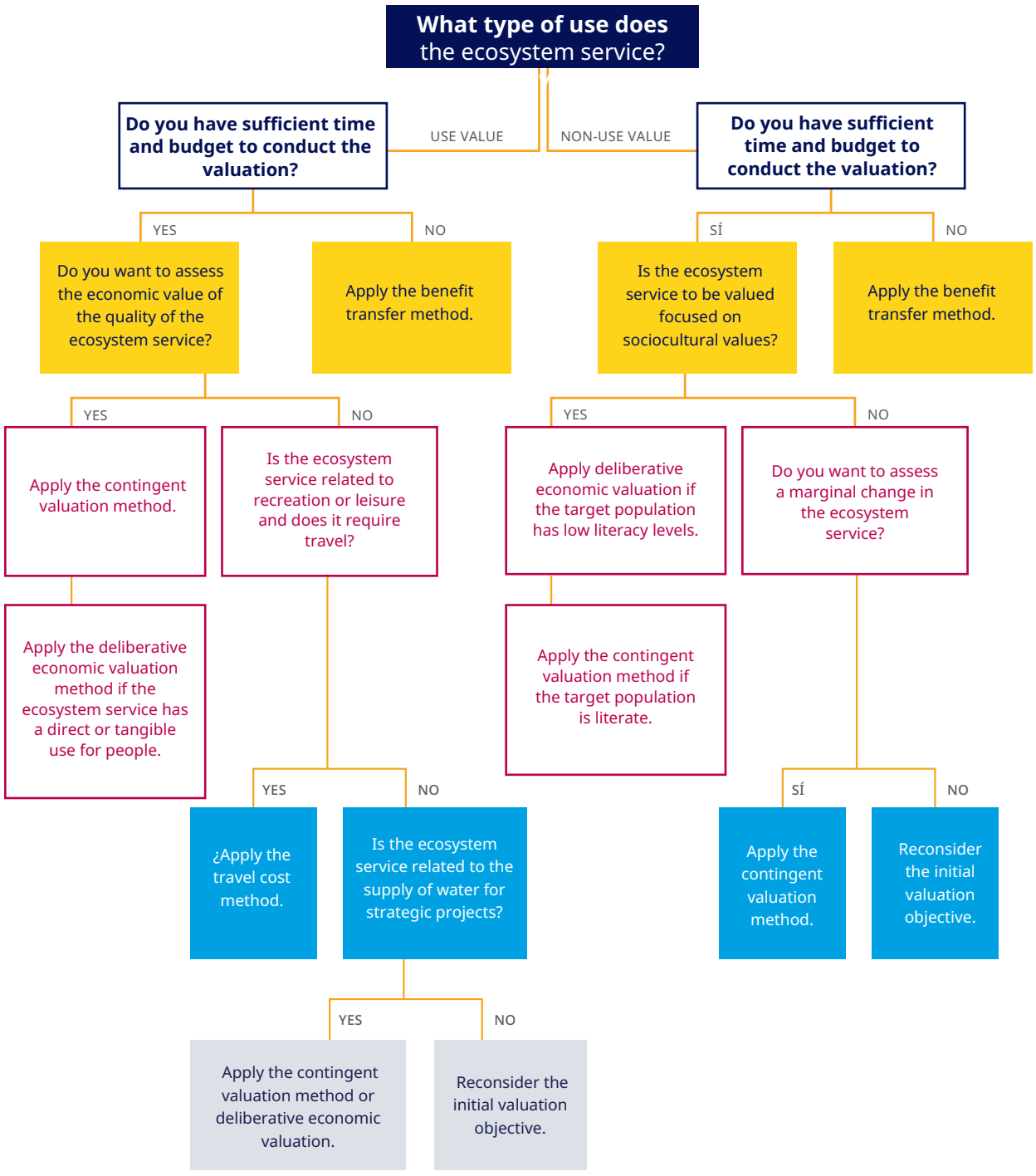
Table 3. Types of Ecosystem Services and Examples of Economic Valuation Cases Associated with Water

Segment	Type of ecosystem service	Examples of economic valuation cases
Water	 	• Environmental services provided by water resources, including surface water and groundwater in all their forms. • Water resources in water protection and food security zones • Raw water tariff • Integrated management and use of water resources

The decision tree for this segment is presented below (Table 3 – Water).

[8] For a detailed review of the valuation cases, please refer to Table 3.

WATER SEGMENT



Decision Tree 5. Water Segment[9]

[9] For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the availability or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their existence. The challenge associated with non-use values is that they are often difficult to measure, which may lead to an underestimation of these services in economic valuation processes (Moreno *et al.*, 2020).

Decision Tree for Ecosystem Services Associated with Environmental Damage

This decision tree covers the Pollution segment, including environmental damage or liabilities, as well as solid, liquid, and gaseous waste.

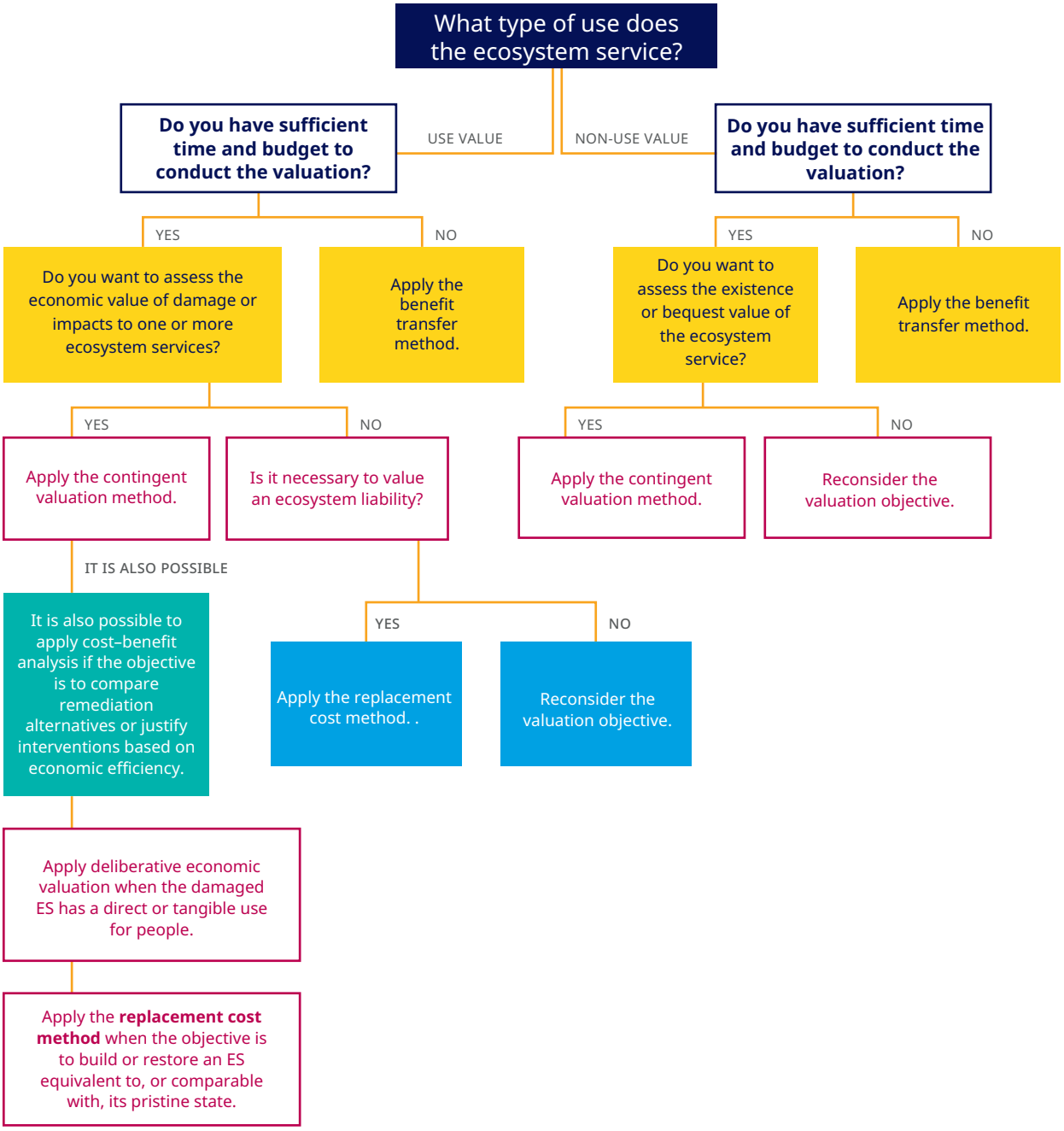
Table 4 presents the types of ecosystem services associated with ecosystem-service valuation cases in this area.

Tabla 4. Types of Ecosystem Services and Examples of Economic Valuation Cases Associated with Environmental Damage

Segment	Type of ecosystemic service	Examples of economic valuation cases
Pollution		• Environmental damage or liabilities due to pollution • Remediation of environmental damage • Ecosystem services affected by solid, liquid, and gaseous waste

The decision tree for this segment is presented below (**Table 4** – Pollution).

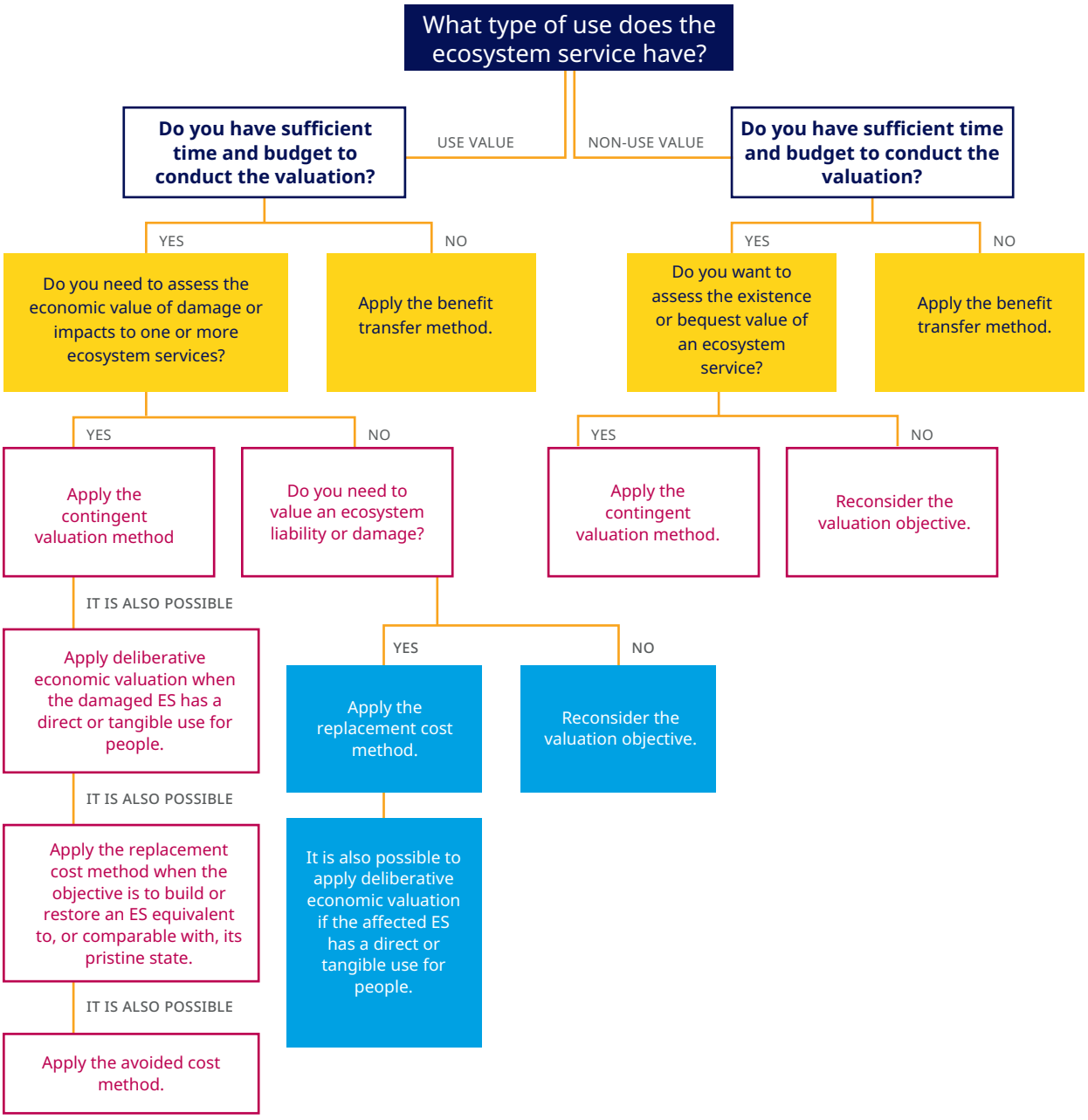
POLLUTION SEGMENT: ECOSYSTEM DAMAGES OR LIABILITIES



Decision Tree 6. Pollution service: enviromental damage or liabilities[10]

[10] For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the availability or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their existence. The challenge associated with non-use values is that they are often difficult to measure, which may lead to an underestimation of these services in economic valuation processes (Moreno et al., 2020).

POLLUTION SEGMENT
SOLID, LIQUID OR GASEOUS WASTE



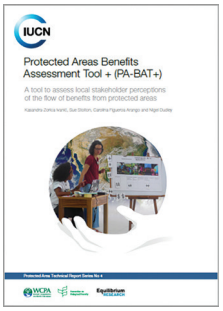
Decision Tree 7. Pollution Segment: solid, liquid, or gaseous waste[11]

[11] For the definition of use value and non-use value, it is important to note that use value refers to natural resources that are consumed directly, indirectly, or potentially in the future. Non-use value refers to the existence or preservation of natural resources so that future generations may benefit from them, as well as to the well-being generated for society simply by their continued existence. The challenge with this type of value is that it is often difficult to measure, which may lead to the underestimation of these services in economic valuation processes (Moreno *et al.*, 2020).

Section 6

Tools for the Economic Valuation of Ecosystem Services

This section presents a set of tools and methods developed in recent years by various organizations and academic institutions that focus on environmental valuation. These freely accessible tools serve as valuable resources to support decision makers in selecting appropriate approaches according to the type of ecosystem service to be valued and the specific needs of management or policy formulation.

TOOL	DESCRIPTION
ValuES	**ValuES** is a robust tool for the economic assessment of ecosystem services, designed to support decision-makers in identifying and quantifying the benefits that ecosystems provide to people. This tool can be applied to a wide range of ecosystems, including forests, oceans, rivers, and lakes. As part of a global project, ValuES provides support to consultants, advisors, academics, and decision-makers in partner countries to facilitate the incorporation of ecosystem services into public policy design, as well as into project planning and implementation. The ValuES Methods Navigator guides users through summaries with practical information and recommendations on the application of different methods, helping them select the most appropriate approach depending on the context. It also includes case studies that illustrate how these methods have been applied in diverse scenarios and decision-making processes.
tessa	The **TESSA Toolkit** (Toolkit for Ecosystem Service Site-based Assessment) is a set of tools designed to provide practical and accessible guidance on low-cost methods for assessing the benefits that people obtain from nature at specific sites. Its objective is to generate useful information that can influence decision-making processes at the local level. Although it was initially developed for conservation professionals, the TESSA Toolkit is also applicable to a broad range of users, including natural resource managers (such as forestry, fisheries, or water management professionals), land-use planners, and development organizations interested in poverty reduction, as well as private-sector actors.
	El **PA-BAT+** (Protected Areas Benefits Assessment Tool +) is a tool designed for use in all protected areas, regardless of their management category or governance regime under the IUCN classification, and it is applicable across all biomes. It can also be used in other conservation contexts. This tool adopts a participatory approach through workshops with local communities and other relevant stakeholders, who identify and discuss the benefits provided by a specific protected area. Benefits are analyzed by distinguishing between economic and non-economic values (such as subsistence), as well as the social groups that perceive them — from local actors to global stakeholders. The process is based on consensus, with the objective of fostering plural dialogue by allowing local stakeholders to express diverse perspectives on the protected area and jointly analyze results.

TOOL	DESCRIPTION
natural capital PROJECT	El **Natural Capital Project** is a collaborative initiative led by the Stanford Center for Conservation Biology, the Stanford Woods Institute for the Environment, The Nature Conservancy, the World Wildlife Fund (WWF), the Chinese Academy of Sciences, the Institute on the Environment at the University of Minnesota, and the Stockholm Resilience Centre. One of its main contributions is the **InVEST** tool (Integrated Valuation of Ecosystem Services and Tradeoffs), a suite of free and open-source models designed to map and value the ecosystem goods and services that support human well-being. **InVEST** allows users to assess the impacts of different land-use or policy scenarios on natural capital, and is widely used in land-use planning, public policy design, and evidence-based decision-making.
TEEB La Economía de los Ecosistemas y la Biodiversidad	The **TEEB** initiative (The Economics of Ecosystems and Biodiversity) seeks to highlight the fundamental role of nature in the economy and in decision-making. Its aim is to demonstrate how biodiversity and ecosystem services have historically been overlooked in decision-making processes by governments, businesses, and social actors at international, national, and local levels. TEEB argues that this lack of recognition is one of the main drivers of current ecosystem degradation. TEEB proposes a structured three-step approach to valuing biodiversity and ecosystem services, based on the following principles 1. **Recognize** the ecological, social, and cultural value of ecosystems. 2. **Demonstrate** that value in economic terms when appropriate and feasible. 3. **Capture** that value through mechanisms and instruments that promote conservation and sustainable use.
WAVES	**WAVES** (Wealth Accounting and the Valuation of Ecosystem Services) is a global initiative led by the World Bank. It aims to promote sustainable development by integrating natural resources into development planning and national economic accounts. WAVES is part of the World Bank's **Programa Global para la Sostenibilidad (GPS)**. The initiative is based on the **Natural Capital Accounting (NCA)**, framework, a set of tools that enables countries to measure, monitor, and manage their natural capital —namely, the ecosystems, minerals, water, forests, and other resources that sustain the economy and human well-being—more effectively.

TOOL	DESCRIPTION
CAPITALS COALITION	The **Natural Capital Coalition** (now known as the **Capitals Coalition**) was established in 2014 as a global multi-stakeholder organization. Its objective is to support the business, financial, and policy communities in integrating ecosystem services and their values into strategic and operational decision-making. The Coalition promotes harmonized and standardized approaches for natural capital assessment, with the aim of strengthening sustainable resource management, mitigating risks, and generating long-term value for both businesses and society.
ARIES	**ARIES** (Artificial Intelligence for Environment & Sustainability) is a framework developed by the Basque Centre for Climate Change (BC3) to integrate multiple paradigms in the spatial modeling and mapping of ecosystem services. It uses AI-based semantic models to quantify ecosystem service flows and enables the incorporation of heterogeneous data and adaptive analysis across different geographic contexts. ARIES also provides an intuitive user interface that facilitates the compilation of accounts within the System of Environmental-Economic Accounting (SEEA), supporting the integration of ecosystem services into planning and decision-making.
Co$ting Nature	**Co$ting Nature** is a spatial mapping and modeling tool for multiple ecosystem services that uses global datasets. It estimates ecosystem services using an opportunity-cost approach, assessing the avoided cost associated with the provision of these services. Developed by King's College London in collaboration with AmbioTEK, the tool is designed to support conservation and land-use planning through high-resolution geospatial analysis.
ENVISION	**Envision** is a tool developed by Oregon State University based on geographic information systems (GIS). Designed for land-use planning and scenario-based environmental valuation, it enables multipurpose modeling by integrating human decision-making into spatial landscape simulations to assess ecological, social, and economic impacts over time. It is particularly useful for exploring alternative land-management strategies and supporting decision-making under different land-use scenarios.
EARTH ECONOMICS	**Earth Economics Tools** provide monetary estimates for natural assets through multiple modules. They include the **Researcher Library**, a database of ecosystem service valuation estimates with advanced search functions and SERVES (Simple Economic Return for Ecosystem Services), a web tool that allows users to calculate the economic value of ecosystem services at specific sites. These tools were developed by Earth Economics to support evidence-based decision-making on the economic value of nature.

Section 7

Integration into the National Enviromental Accounting System

Is essential to link the momentum generated around the economic valuation of ecosystem services through the development of this guide with the process led by the **Ministry of Environment and Energy (MAE)** in its role as the National Environmental Authority. According to current regulations, this process focuses on the following:

- Plan, generate, and update the data management model, as well as analyze and interpret statistical, environmental economic accounting, and geospatial information from the environmental and water resource sectors, among others.
- Coordinate and facilitate the standardized and harmonized management and production of statistical, environmental economic accounting, and geospatial information in these sectors.
- Administer and keep updated the statistical, environmental economic accounting, and geospatial information.
- Analyze, adapt, develop, and update methodologies, instruments, and data sources for the production of statistical, environmental economic accounting, and geospatial information, as well as validate methodologies proposed by technical areas.
- Promote the exchange of statistical, environmental economic accounting, and geospatial information across different sectors
- Analyze and interpret the information generated by the various institutional units in these areas.

In addition, the MAE coordinates its actions with the **National Environmental Accounting System (SCAN)**, which makes it possible to integrate environmental and economic data in order to provide a comprehensive view of the interactions between the economy and the environment. This system includes both environmental assets and flows, expressed in physical and monetary units, in accordance with the **United Nations System of Environmental Economic Accounting (SEEA)**.

The purpose of this section is to present a summary of the main debates and research related to the **relevance of using different economic valuation methods** to estimate exchange values for accounting purposes. This discussion is essential for strengthening the integration of ecosystem services into national accounting and supporting evidence-based decision making.

Economic valuation methodology	Observation	Relevance of including values calculated with the methodology in the SCAN
 Market Prices	It is essential to clearly define the environmental asset to be valued, since this determines the search for and availability of market prices.	Relevant for environmental asset valuation. However, in many cases observable market prices do not exist, making it necessary to apply alternative techniques consistent with the SCAE framework.
 Benefit transfer	Generally used when there is insufficient time or budget to conduct primary valuation. Relies on identifying studies in similar ecosystems.	Not relevant. Because it relies on transferred values from other studies, it presents high uncertainty and is not suitable for official estimates included in SCAN.
 Replacement cost	Requires understanding the ecosystem function and identifying a technical substitute that provides the same service. Value may be overstated if no realistic substitute exists.	Relevant if: (i) the estimate adequately reflects the lost services, (ii) it reflects the minimum cost, and (iii) there is a reasonable expectation that the service can be substituted. Point (iii) may be validated with stated preference methods.
 Travel expenses	The main challenge is isolating the value of the ecosystem from other factors motivating the visit. In some cases, it includes components outside the accounting boundary, such as time value.	Partially relevant. Applicable only if consumer surplus is excluded and the estimated demand curve is used to derive an exchange value consistent with SCAN.
 Deliberative economic valuation	Involves key actors and communities in participatory processes to reflect on ecosystem values, representing diverse visions and local knowledge.	Relevant, especially where cultural, social, or intergenerational values are important. However, methodological integration and validation are required for formal incorporation into the accounting system.
 Contingent Valuation	Used to estimate nonuse values and social welfare. Subject to possible biases depending on survey design and respondent information.	Not directly relevant, as it does not provide exchange values. However, it can inform demand functions from which exchange values consistent with SCAN can be derived.
 Avoided costs	It can be challenging to isolate the specific contribution of an ecosystem service within total avoided costs.	Relevant if: (i) the estimated costs reflect specific ecosystem services, (ii) there is ongoing demand for the service, and (iii) avoided costs are lower than mitigation or replacement alternatives.

Table 5. EVES methodologies and their inclusion in the SCAN

Section 8
References

Aguilera-Klink, F., & Alcántara, V. (1994). *De la economía ambiental a la economía ecológica. FUHEM Ecosocial.* https://www.fuhem.es/media/ecosocial/File/Actualidad/2011/LibroEA_EE.pdf

Azqueta, D., Alviar, M., Domínguez, L., & O'Ryan, R. (2007). I*ntroducción a la economía ambiental* (2.ª ed.). McGraw-Hill.

Bagstad, K. J., Villa, F., Batker, D., Harrison-Cox, J., Voigt, B., & Johnson, G. W. (2014). From theoretical to actual ecosystem services: Mapping beneficiaries and spatial flows in ecosystem service assessments. *Ecology and Society, 19*(2), 64. https://doi.org/10.5751/ES-06523-190264

Barbier, E. (2011). Scarcity and frontiers: *How economies have developed through natural resource exploitation.* Cambridge University Press.

Bateman, I., Carson, R., Day, B., Hanemann, M., Hanley, N., Hett, T., Jones, M., Loomen, G., Mourato, S., Özdemiroğlu, E., Pearce, D., & Elgar, E. (2002). *Economic valuation with stated preference techniques: A manual.* Edward Elgar Publishing.

Bravo, Y. (2018). *Valoración económica de manglares del sur de la reserva (REMACAM) próximos a camaroneras mediante el método de reposición de daño* [Tesis de licenciatura, Pontificia Universidad Católica del Ecuador, Sede Esmeraldas]. https://repositorio.puce.edu.ec/handle/123456789/37608

BISE. (2023, julio). *Biodiversity Information System in Europe.* https://biodiversity.europa.eu

Bouma, J., & Van Beukering, P. (2015). Ecosystem Services: *From Concept to Practice.* Cambridge University Press.

Boyle, P., & Parmeter, C. F. (2017). Benefit transfer for ecosystem services. *University of Miami Working Papers*, 34.

Brander, L. (2013). *Guidance manual on value transfer methods for ecosystem services.* United Nations Environment Programme (UNEP).

Cadena, A., Echeverría, E., Romero, L., Vargas, K., & Rodríguez, F. (2018). Precios de mercado como medio de valoración de los beneficios ambientales de las reservas marino-costeras del Ecuador. *Revista Geoespacial, 15*(1), 60–78. https://journal.espe.edu.ec/ojs/index.php/revista-geoespacial/article/view/1267/935

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature,* 387(6630), 253–260.

Carson, R. T., & Bergstrom, J. C. (2003). *A review of ecosystem valuation techniques*. University of Georgia.

Corona, A., & Martínez, M. (2023). *Preservar y proteger los manglares: tarea de todos.* Veracruz, México.

Daily, G. C., & Ehrlich, P. R. (1999). Managing Earth's ecosystems: An interdisciplinary challenge. *Ecosystems, 2*(4), 277–280.

Daly, H. E. (1997). *Nature's services: Societal dependence on natural ecosystems*. Island Press.

Earth Economics. (2010). *Nature's value in the Térraba-Sierpe National Wetlands: The essential economics of ecosystem services.* https://www.eartheconomics.org/publications-archive

Emerton, L. (1996). Valorando el uso de subsistencia de los productos forestales en el Bosque de Oldonyo Orok, Kenya. *Rural Development Forestry Network Paper.* https://www.researchgate.net/publication/265116093

Fish, R., Burgess, J., Chilvers, J., Footitt, A., & Turner, K. (2011). *Participatory and deliberative techniques to support the monetary and non-monetary valuation of ecosystem services: An introductory guide.* Department for Environment, Food and Rural Affairs (UK).

Flores, N. (2019). *Valoración de los costos evitados en la población adulta por el mejoramiento de agua de consumo en la parroquia San Isidro, provincia de Manabí (2018-2019)* [Tesis de grado, Pontificia Universidad Católica del Ecuador]. https://repositorio.puce.edu.ec/items/22058f33-d863-4e1f-a2a6-6e8ef72b11c3

Fondo para la Protección del Agua (FONAG). (2006). *Cadenas agroproductivas para la conservación media de la cuenca del río Pita.* Desde el SURCO. Compartiendo Experiencias No. 5.

García, H., Corredor, A., Calderón, L., & Gómez, M. (2013). *Análisis costo-beneficio de energías renovables no convencionales en Colombia.* FEDESARROLLO. https://www.repository.fedesarrollo.org.co/handle/11445/331

GIZ & Helmholtz Centre for Environmental Research. (2013-2018). *ValuES: Methods for integrating ecosystem services into policy, planning, and practice.* International Climate Initiative (IKI).

Haab, T. C., & McConnell, K. E. (2002). *Valuing environmental and natural resources: The econometrics of non-market valuation.* Edward Elgar Publishing.

Harrison, P. A., Dunford, R., Lundy, L., Berry, P. M., & Smith, A. (2018). Selecting methods for ecosystem service assessment: A decision tree approach. *Ecosystem Services,* 29(Part C), 481–498. https://doi.org/10.1016/j.ecoser.2017.09.016

Herrera, M. (2014). *Valoración económica del ecoturismo como una actividad viable para el desarrollo sustentable de las áreas protegidas del Ecuador: Aplicación del método de costos de viaje en la Reserva de Producción Faunística Cuyabeno* [Tesis de grado, Pontificia Universidad Católica del Ecuador]. https://repositorio.puce.edu.ec/handle/123456789/33629

INABIO. (s. f.). *Perfil de biodiversidad.* Instituto Nacional de Biodiversidad. http://inabio.biodiversidad.gob.ec/perfil-de-biodiversidad

Iovanna, R., & Griffiths, C. (2006). Clean water, ecological benefits, and benefits transfer: A work in progress at the U.S. EPA. *Ecological Economics, 60*(2), 473–482. https://doi.org/10.1016/j.ecolecon.2006.06.012

Jamouli, A., & Allali, K. (2020). Economic valuation of ecosystem services in Africa. *EDP Sciences,* 17, 01003.

Johnston, R. J., Rolfe, J., Rosenberger, R. S., & Brouwer, R. (2015). *Benefit transfer of environmental and resource values: A guide for researchers and practitioners*. Springer.

Kelemen, E., & Gómez-Baggethun, E. (2010). *Participatory methods for valuing ecosystem services.* United Nations University Institute of Advanced Studies.

Kelemen, E., & Saarikoski, H. (2015). *Method factsheet: Deliberative valuation.* https://oppla.eu/resource/deliberative-valuation-methodological-guidelines

King, D., & Mazzotta, M. (2000). *Methods: Market price method estimates economic values for ecosystem products or services that are bought and sold in commercial markets.* Ecosystem Valuation. https://www.ecosystemvaluation.org/uses.htm

Kinh Bac, D., Thi Thanh, H. P., Thu Thuy, N., Thi Phuong, N. P., Manh Ha, N., Van Bao, D., ... & Van Liem, N. (2022). Economic valuation of wetland ecosystem services in northeastern part of Vietnam. *Knowledge and Management of Aquatic Ecosystems*, 14. https://doi.org/10.1051/kmae/2022010

Lee, S. L., Then, A. Y.-H., Hattam, C., Jones, A. E., & Austen, M. (2022). Strengthened multi-stakeholder linkages in valuation studies is critical for improved decision making outcomes for valuable mangroves – The Malaysian case study. *Frontiers in Marine Science*, 9, Article 894062. https://doi.org/10.3389/fmars.2022.1033200

Leff, E. (2004). *Racionalidad ambiental. La reapropiación social de la naturaleza.* Siglo XXI.

Llanes, J. (Coord.). (2012). Introducción a la economía ambiental. En H. Ferro (Ed.), *El análisis económico del impacto ambienta*l (p. 171). Facultad de Artes y Letras, Universidad de La Habana.

MAE & GIZ. (2017). *Guía de valoración económica de los recursos genéticos de los anfibios en Ecuador.* Ministerio del Ambiente del Ecuador y Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

MAE, UICN & GIZ. (2018). *Programa de desarrollo de capacidades sobre adaptación basada en ecosistemas: Módulo 1. Documento de lectura.* Programa Regional "Estrategias de Adaptación al cambio climático basadas en Ecosistemas en Colombia y Ecuador".

Mankiw, N. G. (2012). *Principios de economía* (6.ª ed.). Cengage Learning.

Martínez-Alier, J. (1998). *Curso de economía ecológica.* Programa de las Naciones Unidas para el Medio Ambiente (PNUMA), Oficina Regional para América Latina y el Caribe. https://storage.e.jimdo.com/file/7cfd81ed-4932-43a1-8518-c30ce6d2ea5e/Martinez%20Alier%20Corso%20Ec%20ecol.pdf

Mavsar, R., Herreros, F., Valera, E., Gouriveau, F., & Duclercq, M. (2013). *Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems.* EFIMED y CTFC para Plan Bleu.

Mayer, M., & Woltering, M. (2018). Assessing and valuing the recreational ecosystem services of Germany's national parks using travel cost models. *Ecosystem Services,* 31(Part C), 371–386. https://doi.org/10.1016/j.ecoser.2017.12.009

Merlin, H., & Reid, J. (2017). Valuing urban open space using the travel-cost method and the implications of measurement error. *Journal of Environmental Management,* 198(Part 2), 50–65. https://doi.org/10.1016/j.jenvman.2017.05.005

Millennium Ecosystem Assessment. (2005). *Ecosystems and human well-being: Synthesis. Island Press.* https://www.millenniumassessment.org/documents/document.356.aspx.pdf

Myrick, F. (2003). *The measurement of environmental and resource values: Theory and methods.* Resources for the Future.

Obeng, E., Obiri, B., Oduro, K., Pentsil, S., Anglaaere, L. C. N., Foli, E. G., & Ofori, D. A. (2020). Economic value of non-market ecosystem services derived from trees on cocoa farms. *Current Research in Environmental Sustainability*, 2. https://doi.org/10.1016/j.crsust.2020.100019

Osorio, E. (2021). *Valoración costo-beneficio del manejo integral de los residuos sólidos aplicable a conjuntos residenciales en la ciudad de Cali. Caso de estudio: Coofundadores* [Tesis de grado, Universidad del Valle]. https://bibliotecadigital.univalle.edu.co/server/api/core/bitstreams/3b09567f-4443-4f73-970e-626bc56c2903/content

Pagiola, S., Bishop, J., & Landell-Mills, N. (2003). *Selling forest environmental services: Market-based mechanisms for conservation and development.* Earthscan.

Parsons, G. (2003). The Travel Cost Model. En P. A. Champ, K. J. Boyle, & T. C. Brown (Eds.), A Primer on Nonmarket Valuation (pp. 269-329). Springer Netherlands.

Paspuel, V. (2009). *Valoración económica del servicio ambiental hídrico: estudio de caso del abastecimiento de agua de la ciudad de Tulcán* [Tesis de maestría, FLACSO Ecuador]. https://repositorio.flacsoandes.edu.ec/bitstream/10469/1464/4/TFLACSO-2009VPM.pdf

Pearce, D. W. (1985). *Economía ambiental.* Fondo de Cultura Económica.

Polasky, S., & Segerson, K. (2009). Integrating ecology and economics in the study of ecosystem services: Some lessons learned. *Annual Review of Resource Economics,* 1, 409–434. https://doi.org/10.1146/annurev.resource.050708.144110

Quillérou, E. (2019). ELD CAMPUS module: Valuation of ecosystem services. En *The Economics of Land Degradation Initiative (ELD).*

Ramírez, C., Ríos, C., & Morales, T. (2010). Estimación de costos inducidos derivados de la calidad del agua potable en Risaralda. *Scientia et Technica, 16*(44), 271–276. https://dialnet.unirioja.es/descarga/articulo/4562424.pdf

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

Riera, P., & Signorello, G. (2012). *Good practice guidelines for the non-market valuation of forest goods and services.* University of Catania, Department of Agri-food and Environmental System Management.

Sundberg, S. (2004). Replacement costs as economic values of environmental change: A review and an application to Swedish sea trout habitats. *Beijer Discussion Paper Series No. 181*. The Beijer Institute of Ecological Economics.

TEEB. (2010). *The economics of ecosystems and biodiversity: Ecological and economic foundations*. Earthscan.

Toledo, D., & Briceño, T. (2018). Ecosystem service valuation framework applied to a legal case in the Anchicayá region of Colombia. *Ecosystem Services,* 29(Part B), 352–359. https://doi.org/10.1016/j.ecoser.2017.02.022

UNEP. (2014). *Guidance manual on valuation and accounting of ecosystem services for Small Island Developing States*. Ecosystem Services Economics Unit, Division of Environmental Policy Implementation.

Vargas, A. (2015). Valoración monetaria deliberativa: preferencias y participación. *Ambiente y Sostenibilidad, 5*(1), 57–68. https://revistaambiente.univalle.edu.co/index.php/ays/article/view/4302

Wallace, R. (2007). Agricultural productivity and environmental degradation. *Agricultural Economics, 36*(3), 253–264. https://onlinelibrary.wiley.com/doi/10.1111/j.1574-0862.2007.00207.x

Whitehead, J. C. (2006). A practitioner's primer on the contingent valuation method. En A. Alberini & J. R. Kahn (Eds.), *Handbook on contingent valuation* (pp. 92–115). Edward Elgar Publishing.

Section 9

Frequently Asked Questions

1. What happens when there is no secondary information available to conduct an environmental economic valuation study?

When planning an ecosystem services valuation study and sufficient secondary information is not available, whether quantitative or qualitative, it is necessary to generate primary information. Various techniques may be used for this purpose, such as direct observation, geospatial data collection, biological sampling, expert interviews, and surveys, among others. It is important to consider that generating primary information requires a significant investment of time and financial resources, which must be considered by the institution interested in conducting the environmental economic valuation study

2. Do the methodologies presented in this guide require a minimum amount?

There is no predefined minimum time for implementing an environmental economic valuation study. The duration may vary significantly depending on several factors, including the complexity of the ecosystem or context to be evaluated, the availability and quality of data, the size of the study area, the purpose of the analysis, and the financial resources available.

Some studies can be completed in a relatively short period if they rely on easily accessible secondary information and straightforward methods. More complex studies that require the collection of primary information through surveys, fieldwork, or detailed technical analysis may require significantly more time.

It is essential to establish a realistic timeline for the study, considering its objectives, scope, level of complexity, and budget constraints. This ensures both the quality and usefulness of the results.

3. Which free websites are recommended for accessing secondary information for environmental economic valuation studies?

Name and description	Website
Directory of Open Access Journals (DOAJ) The Directory of Open Access Journals (DOAJ) is a directory of open access scientific journals covering a wide range of disciplines, including environmental economics. It provides free access to peer-reviewed articles, making it a reliable source for updated and high-quality academic literature.	**https://doaj.org/**
AgEcon Search The Directory of Open Access Journals (DOAJ) is a database of open access scientific journals covering a wide range of disciplines, including environmental economics. It provides free access to peer-reviewed articles, making it a reliable source of current and high-quality academic literature. https://doaj.org/.	**https://ageconsearch.umn.edu**
World Digital Library The World Digital Library provides free access to a diverse collection of manuscripts, maps, books, photographs, and other cultural and academic materials from around the world. Although its main focus is historical and cultural, it includes documents relevant to environmental, economic, and sustainable development topics that can serve as useful context or supplementary information for environmental economic valuation studies.	**https://www.wdl.org**
University repositories Many universities maintain open access institutional repositories that host theses, dissertations, and academic articles related to environmental economic valuation. These repositories are a valuable source of local and applied information and are particularly useful for case studies in specific geographic or thematic contexts. **Websites** The following repositories offer open access to theses, dissertations, scientific articles, and other academic documents relevant to environmental economic valuation studies and related topics: San Francisco de Quito University (USFQ) **https://repositorio.usfq.edu.ec** Pontificia Universidad Católica del Ecuador (PUCE) **http://repositorio.puce.edu.ec** Escuela Superior Politécnica del Litoral (ESPOL) **https://www.dspace.espol.edu.ec** Yachay Tech University **https://repositorio.yachaytech.edu.ec/home** Escuela Politécnica Nacional (EPN) **https://bibdigital.epn.edu.ec** Universidad Central del Ecuador (UCE) **http://www.dspace.uce.edu.ec** Latin American Faculty of Social Sciences (FLACSO Ecuador) **https://repositorio.flacsoandes.edu.ec** Cuenca University **https://dspace.ucuenca.edu.ec** Técnica Particular de Loja University (UTPL) **https://dspace.utpl.edu.ec** Armed Forces University (ESPE) **https://repositorio.espe.edu.ec** Técnica de Ambato University (UTA) **https://uta.edu.ec/bibliotecas-uta/**	
Open Knowledge Repository of the World Bank The World Bank Open Knowledge Repository provides free access to an extensive collection of publications, technical reports, papers, books, and book chapters related to sustainable development, environmental economics, ecosystem service valuation, natural resources, climate change, and public policy. It is a dependable and up to date source for researchers, decision makers, and development professionals.	**https://openknowledge.worldbank.org/home**

Name and description	Website
Google Scholar Google Scholar is a specialized search engine that allows users to locate academic literature, including peer reviewed articles, theses, books, abstracts, and technical studies across various disciplines, such as environmental economics and ecosystem service valuation. Although it is not a digital library itself, it is widely used to access research published in multiple repositories and academic journals.	**https://scholar.google.com/**

International Organizations

Various international organizations make studies, reports, and free databases available to the public on topics related to the environment, climate change, and the economic valuation of natural resources. These publications constitute an important source of secondary information for technical and academic studies.

Websites

World Bank – Open Knowledge Repository
https://openknowledge.worldbank.org
https://documentos.bancomundial.org/es/publication/documents-reports

United Nations Environment Programme (UNEP)
https://www.unep.org/es

Organisation for Economic Co-operation and Development (OECD) – Environment
https://www.oecd.org/environment/

Economic Commission for Latin America and the Caribbean (ECLAC)
https://www.cepal.org/es/temas/medio-ambiente
https://repositorio.cepal.org/home

United Nations – Library System
https://research.un.org/es/docs/unsystem/unep
https://www.un.org/es/library/page/un-libraries

Food and Agriculture Organisation of the United Nations (FAO)
https://www.fao.org/publications/es
https://www.fao.org/legal-services/biblioteca/biblioteca/es/

World Wildlife Fund (WWF) – Ecuador
https://www.wwf.org.ec/bibliotecavirtual/publicacionesec/

Intergovernmental Panel on Climate Change (IPCC)
https://www.ipcc.ch/library/

Convention on Biological Diversity (CBD)
https://www.cbd.int/information/library.shtml

Global Environment Facility (GEF)
https://www.thegef.org/

Green Climate Fund (GCF)
https://www.greenclimate.fund/

Inter-American Institute for Cooperation on Agriculture (IICA)
https://repositorio.iica.int/home

In Ecuador, several institutions that generate and manage statistical, environmental, economic, and sector specific information that can serve as secondary sources for environmental economic valuation studies.

Websites

National Institute of Statistics and Census (INEC)

Provides official statistics on population, employment, agriculture, the environment, and other sectors.
https://www.ecuadorencifras.gob.ec/institucional/home/

Central Bank of Ecuador (BCE)
Offers macroeconomic data, national accounts, environmental accounts (SCAN), and monetary statistics.
https://www.bce.fin.ec/

Ministry of Agriculture and Livestock (MAG)
Through the Public Agricultural Information System (SIPA), provides agricultural and livestock data, price information, and cultivated area statistics.
http://sipa.agricultura.gob.ec/

Ministry of Environment, Water and Ecological Transition (MAATE)
Manages platforms with geospatial information, biodiversity data, protected areas, and water resources.

Single Environmental Information System (SUIA)
http://suia.ambiente.gob.ec/

National Environmental Information System (SINIA)
https://sinias.ambiente.gob.ec/proyecto-sinias-web/start.jsf?utm_source

Ministry of Production, Foreign Trade, Investment, and Fisheries
Through the Integrated Production Information System (SIIPRO), provides data on productive sectors, foreign trade, and industrial employment.
https://servicios.produccion.gob.ec/siipro/?utm_source

4. Why and when should ecosystem services be valued?

Valuing ecosystem services is essential to make their contribution to the economy and society visible. Below are the main reasons why this valuation is necessary, as well as the context in which it is recommended.

Why should an environmental service be valued?

- **Decision making.** Valuation provides quantitative information that helps decision makers understand the benefits and costs associated with conserving and managing natural resources and ecosystems.

- **Resource allocation.** It supports the efficient allocation of resources by prioritizing investments in the protection or restoration of ecosystem services that generate the greatest economic and social benefits.

- **Awareness and public engagement.** Economic valuation can be a powerful tool to raise awareness among stakeholders and the general public about the importance of ecosystem services and their contribution to the economy and human wellbeing.

- **Environmental impact assessment.** Environmental impact assessment. In the context of projects or policies that may affect the environment, valuation helps identify and measure potential environmental and economic impact.

- **Sustainable planning.** It facilitates long term planning and the sustainable management of natural resources, promoting a forward looking and informed approach to decision making.

- **Policy assessment.** It enables the evaluation of the effectiveness of existing environmental and conservation policies and helps justify the need for new policies and instruments.

When should an environmental service be valued?

- **Project assessment.** Before developing projects such as dams, hydropower facilities, wind energy systems, mining or oil extraction activities, or roads, it is essential to value the ecosystem services that could be affected.

- **Natural resource management.** Valuation supports the sustainable management of natural resources, such as forests, wetlands, rivers, and oceans, helping ensure long term environmental, social, and economic benefits.

- **Environmental impact assessment.** Ecosystem service valuation is used in environmental impact assessments to understand the effects that projects may have on the environment and the economy.

- **Public policy analysis.** Help evaluate existing and proposed public policies to identify their economic and environmental impacts.
- **Protected area management.** Valuation plays an essential role in the management of protected areas, as these territories provide high value provisioning, regulating, supporting, and cultural ecosystem services.

- **Climate change.** Economic valuation is important for understanding and addressing the economic, social, and environmental impacts associated with climate change.

5. How should one proceed when facing multicriteria cases where a single decision tree is not sufficient?

When dealing with complex decisions that involve multiple objectives and criteria, multicriteria analysis (MCA) offers a robust methodological approach to assess options without converting all criteria into monetary terms. This approach is widely used in ecological economics and allows the integration of environmental, social, technical, and economic perspectives in a transparent and participatory manner.

Some of the most commonly used MCA methods include:

- Multi Attribute Utility Theory (MAUT)
- Analytic Hierarchy Process (AHP)
- Outranking methods
- Qualitative and fuzzy methods
- REGIME Method
- MACBETH (Measuring Attractiveness by a Categorical Based Evaluation Technique)

These methods enable the comparison of alternatives based on the relative importance assigned to different criteria, and they are useful for generating recommendations in environmental planning and public policy processes.

6. What are the minimum components required for implementing different methodologies (surveys)?

The design and implementation of surveys for environmental economic valuation studies must include key elements that ensure the quality and usefulness of the information collected.

- **Clear objective.** Define the purpose of the survey and the specific information to be obtained.

- **Sample design.** Identify the target population and determine the appropriate sample size using suitable sampling techniques to ensure representativeness (Lohr, 2019).

• **Questionaire structure.** Formulate clear, relevant, and unambiguous questions aligned with the objectives of the study.

• **Type of questions.** Select open ended, closed, multiple choice, or Likert scale questions, depending on the intended analysis.

• **Data collection.** Choose the most efficient method (in person, telephone, or digital), using tools such as KoboToolbox or SurveyCTO to facilitate data collection and management.

• **Pilot test.** Conduct a preliminary validation with a small group to detect errors or ambiguities in the questionnaire (Collins, 2003).

• **Informed consent and privacy.** Include statements on data use to ensure participant confidentiality and informed consent.

• **Data analysis.** Define the methods for processing and analyzing the information collected, whether statistical, qualitative, or mixed approaches.

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