ICIMOD Technical report

Framework for Valuing Ecosystem Services in the Himalayas

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Framework for Valuing Ecosystem Services in the Himalayas

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Introduction

Mountains occupy 24% of the global land surface area and are home to 12% of the world's population. Mountains have an ecological, aesthetic, and socioeconomic significance, not only for those living in the mountain areas, but also for people living beyond them. About 10% of the world's population depends directly on mountain resources for their livelihoods and wellbeing, and an estimated 40% depends indirectly on mountain resources for water, hydroelectricity, timber, biodiversity and niche products, mineral resources, flood control, and recreation (Schild 2008). Despite their important contribution, mountains are still marginalised in the development agenda. The importance of ecosystem services arising from mountains is not properly recognised. Approaches to economic valuation of services and payment mechanisms in mountain areas are needed to comprehend and realise the benefits. However, as yet these have only been developed to a very limited extent.

Recently there have been some developments in applying economic thinking to the use of biodiversity and ecosystem services. The two critical points to consider are (1) why prosperity and poverty reduction depends on maintaining the flow of benefits from ecosystems; and (2) why successful environmental protection needs to be grounded in sound economics, including explicit recognition, efficient allocation, and fair distribution of the costs and benefits of conservation and sustainable use of natural resources (TEEB 2010a). There is also a compelling cost-benefit case for public investment in ecological infrastructure (especially restoring and conserving forests, river basins, wetlands, and others), particularly because of its significant potential as a means of adaptation to climate change (TEEB 2009a). Another dimension is that payments for ecosystem services, or PES, are generating considerable attention because they have the potential to create new funding opportunities for biodiversity protection and other ecosystem services that contribute to human wellbeing. Natural systems in the mountains provide an excellent opportunity for promotion of the recently emerging concept of the 'green economy'. Awareness of the value of ecosystem services has grown rapidly in recent times; the recent Convention on Biological Diversity Conference of the Parties (COP-10 in Nagoya, October 2010) led the global players to declarations on making the use of environmental goods part of the national accounts.

While awareness of the value of mountain ecosystems is increasing, there is a need to develop sound methodologies for valuing them in order to realising the benefits. This paper aims to bridge this gap by outlining a general framework for economic valuation of ecosystem services focusing on mountain specific situations, which could be applied in the Hindu Kush-Himalayan region.

Mountain ecosystem services

Ecosystems are capital assets that provide a wide range of services. These include supporting services that maintain the conditions for life; provisioning services that provide direct inputs to livelihoods and the economy; regulating services such as those that provide flood and disease control; cultural services that provide opportunities for recreation, and spiritual or historical sites; and supporting services that sustain and fulfil human life (MA 2005). Increasing demands on ecosystem goods and services are now putting pressure on the natural resources that they contain.

Excessive demands on ecosystems diminish their capacity so that there is a growing need both to promote their sustainable use and to preserve biodiversity (e.g., Daily and Walker 2000; MA 2005; EPA 2009). Ecosystem services are defined by the Millennium Ecosystem Assessment (MA 2005) as 'the benefits people obtain from ecosystems'; however, these are often not fully understood as many of the services, such as regulating and supporting services, are intangible and do not have an explicit market value. As ecosystem services are not fully captured in markets or adequately valued in monetary terms, they are often taken for granted and do not receive due importance in policy decisions (Costanza et al. 1997; Bernard et al. 2009; TEEB 2008, 2009b, 2010b). Moreover, lack of knowledge of the monetary value of ecosystem goods and services is not the only factor leading to resource degradation. There are many other proximate factors such as existing policies and practices, demand on existing services, and the opportunity costs of conserving services, which add complexities to our understanding of the value of these resources. As a result, there is suboptimal investment in conservation and management which leads to ecosystem deterioration (MA 2005).

The Hindu Kush-Himalayan (HKH) region is endowed with a rich variety of gene pools and species, and ecosystems of global importance. It is a storehouse of biological diversity and a priority region in many global conservation agendas (Brookes et al. 2006). The region has many unique ecosystems that play a critical role in protecting the environment and in providing livelihoods for much of Asia and beyond (Erikson et al. 2009). The ecosystem services provided by the HKH include freshwater which is used by more than 200 million people living in the region and by 1.3 billion people living in the ten downstream river basins (Schild 2008). The HKH is also home to all or part of four global biodiversity hotspots and several endangered species and it is an important component of the global ecosystem (Chettri et al. 2008a). The countries of the HKH have set aside more than 39% of their most biologically rich terrain for protected area management; in total, the HKH houses 488 protected areas, 29 Ramsar Sites, 13 UNESCO Heritage Sites, and 330 Important Bird Areas (Chettri et al. 2008a).

The ecosystems of the HKH, like many other ecosystems worldwide, are being degraded by anthropogenic factors (Xu et al. 2008). Growing demand for ecosystem goods and services stemming from a burgeoning human population and haphazard infrastructure development, combined with unsustainable use, poor management, and low investment in conservation, have all led to habitat degradation, biodiversity loss, and decreased agricultural productivity (Chettri et al. 2008b; Xu et al. 2008; GOI 2009; Sharma et al. 2009; Tse-ring et al. 2010). The extensive modification of vital ecosystems may affect their natural processes and reduce their capacity to provide services in future; however, with the exception of a few empirical studies (for example Maharana et al. 2000a, b; Baral et al. 2007, 2008; Badola et al. 2010; Chen and Jim 2010) there have been no serious efforts to assess the value of the ecosystem services of the HKH region.

Valuation of mountain ecosystem services is a challenge because of the biophysical characteristics of high altitude and slope as well as the large variation in temperature and moisture which results in a high degree of heterogeneity. Himalayan ecosystems and their associated biodiversity are highly dynamic and multifunctional and they interact in complex ways. Different services are interlinked and highly interdependent (Ring et al. 2010). The fact that natural processes are highly variable over space and time poses a challenge for economists when they attempt to assign the value of particular ecosystems at multiple spatial and temporal scales (TEEB 2008; Koch et al. 2009; de Groot et al. 2010; Ring et al. 2010). Moreover, the relationship between ecological traits and ecosystem functions and services is not linear (Koch et al. 2009). For example, there may be a relationship between biological diversity and plant growth, but when the biological diversity is lost certain plants may not grow at all. The challenge is to assign a value to multifunctional mountain ecosystems and to determine threshold values (Ring et al. 2010).

The concept of ecosystem service value can be a useful guide when distinguishing and measuring where trade-offs between society and the rest of nature are possible and where they can be made to enhance human welfare in a sustainable manner (Dasgupta 2009, 2010; DEFRA 2010; UK National Ecosystem Assessment 2010). However, while win-win opportunities for human activities within the environment may exist, they also appear to be increasingly scarce in a 'full' global ecological-economic system. This makes valuation all the more essential for guiding future human activity (Faber et al 2002). Quantifying the economic value of ecosystem services is useful for strengthening the case for conservation and providing a base for informed policy decisions (Dale and Polasky 2007; Swinton et al. 2007), however, methodological difficulties remain an obstacle to estimating the economic value (Bräuer, 2003; Nijkamp et al. 2008). The mountain specificities of inaccessibility, fragility, marginality, and physical and economic vulnerability; as well as the fact that inadequate attention has been paid to the subject in the HKH region, are additional factors limiting our understanding of the true value of resources (Jodha 1992, 2000, 2004). Most of the critical conservation areas in the HKH region are located in remote and poorly accessible areas. The local communities living in these fragile areas have limited livelihood options, and often receive little benefit from development activities. Although some of the provisioning services such as food are relatively easy to assess in monetary terms; others, which do not have a direct market value, pose a greater challenge. Ecosystem services are also vulnerable to natural disasters such as landslides, floods, and the impacts of climate change.

This paper outlines a general framework for economic valuation of ecosystem services in the HKH region. The framework is a generic first attempt that will need to be fine-tuned and customised for each type of ecosystem and each kind of service value. A glossary of important terms is provided at the back.

Role of Economic Valuation

There are various reasons why it is important to value ecosystem services, and different ways in which economic valuation helps in improving ecosystem management. Among others, economic valuation is a pre-requisite for developing programmes on payments for ecosystem services (PES). The major reasons for economic valuation are summarised in the following.

Raising awareness: Assigning a monetary value to ecosystem services in mountain areas will help to raise awareness of the importance of the services that upstream systems provide to downstream users. For example, when biodiversity conservation or carbon sequestration in mountain ecosystems is expressed in monetary terms, it will highlight the significance that these ecosystems have for local, national, regional, and global communities, and can help to overcome existing policy dilemmas concerning their conservation (Costanza et al. 1997; Daily et al. 2000; TEEB 2009b).

Creating a 'market' for ecosystems: Valuation of ecosystem services is essential for creating a market. Economic valuation of ecosystem services not only demonstrates the importance and value of mountain ecosystems, but also provides insights about the gains and losses faced by different stakeholders directly or indirectly due to ecosystem degradation and subsequent loss of these services (Kumar 2005). Economic valuation can contribute to conservation of mountain ecosystems by rewarding mountain communities for their conservation of the ecosystem resources.

Improving management mechanisms: Valuation also helps in deciding between different policy options, in identifying more efficient and cost effective alternatives, and in designing appropriate institutional and market (and non-market) instruments, including payment for ecosystem services (PES). While valuation is a necessary first step, it is usually not sufficient in and of itself. For example, to make PES operational, it will also be necessary to mount a concerted effort in which clear roles are defined for multiple stakeholders and well-defined mechanisms are put in place to facilitate and negotiate transactions and decision making (Huang and Upadhyaya 2007; UK National Ecosystem Assessment 2010).

Providing a framework for decision making: Valuation techniques will provide supporting arguments for the protection of biological resources. They would also help to improve our understanding of ecosystems in general by evaluating the costs and benefits of development and environmental decisions as a trade-off between the resources and their utility values. Valuation will play an important role in decision making and prioritisation in resource allocation, distribution, and management. In many countries, investment decisions on public goods and utilities such as dams, roads, and others often ignore the possible impacts (and real financial implications) that these activities have for the environment and for livelihoods

(Bateman et al. 2010). Pearce (2001) argues that measuring the economic value of ecosystem services is a fundamental step in conserving resources since "the pressures to reduce biodiversity-based goods and services are so large that the chances that we will introduce incentives [for the protection of biodiversity] without demonstrating the economic value are much less than if we do engage in valuation".

Assigning a monetary value to biodiversity and to the services derived from it is important because it means that the benefits associated with biodiversity are able to be directly compared with the economic value of alternative resource use options (see also Nunes and van den Bergh 2001). The Organisation for Economic Co-operation and Development (OECD) (OECD 2001) has recognised the importance of measuring the economic value of biodiversity and identified a wide range of uses for such values; these include demonstrating the value of biodiversity when targeting biodiversity protection within scarce budgets, and in liability regimes, determining the value of damage when biodiversity is lost. The role of environmental valuation methodologies in policy formulation is increasingly recognised by policymakers. The Convention on Biological Diversity's Conference of the Parties decision IV/10 acknowledges that "economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures" and encourages parties, governments, and relevant organisations to "take into account economic, social, cultural, and ethical valuation in the development of relevant incentive measures".

Extending justice and equity: When valuations have been conducted, it is possible to show how costs and benefits are distributed across society. In addition, when a compensation mechanism exists, it is possible to extend justice and equity by distributing the benefits and costs of any change in ecosystem services. This can facilitate cost-sharing for management initiatives that provide incentives to the poor, who are the main custodians of mountain ecosystems. The traditional knowledge systems, and promotion of access and benefit sharing (ABS) of genetic resources, are important elements to be considered.

In general, uplanders are the custodians of mountain ecosystem services and downstream dwellers are the beneficiaries. PES schemes are based on the principle that those who benefit from ecosystem services should pay for them, and that those who contribute to generating services should be compensated. They focus directly on creating a conditional benefit transfer between the providers of ecosystem services and the beneficiaries. However, providing an equitable share at the micro-level (such as for the poorest of the poor) is still a challenging task. Hence, the approach seeks to create mechanisms that internalise what would otherwise be an externality (Pagiola et al. 2008).

Fundamental Issues of Economic-ecological Integration

Economic valuation of an ecosystem requires a clear understanding of both the ecological and economic aspects and of how these are interrelated. Ecosystems are highly interdependent and often the survival of one species depends on the existence of another – the ecological threshold and interdependency of the different components is essential to the survival of the ecosystem as a whole. It is thus important to integrate both ecological and economic perspectives into the valuation.

An ecological perspective encompasses how the ecosystem structure, function, and processes interact and how this relates to the production system of goods and services (Robinson and Venema 2006). **Ecosystem structure** refers both to the composition of the ecosystem (i.e., its various parts) and to the physical and biological organisation defining how those parts are organised. **Ecosystem function** describes a process that takes place in an ecosystem as a result of the interactions that plants, animals, and other organisms have with each other and/or with their environment. **Ecosystem processes** refer to the complex interactions (events, reactions, or operations) among biotic and abiotic elements of an ecosystem that lead to definite results. Key processes include the energy, nutrient, carbon, oxygen, and water cycles and fluxes (Wallace 2007).

An economic perspective is needed in order to estimate the value of ecosystem functions and the tangible and intangible goods and services associated with them. Since ecological interpretation of ecosystem functions and services forms the basis for economic analysis, it is first necessary to understand the characteristics of an ecosystem and its underlying linkages and dependencies.

An ecosystem can be characterised by three related concepts: stocks and flows, and the organisation of these stocks and flows. These three system characteristics have parallel concepts in ecology (structural components, environmental functions, and diversity) and in economics (assets, services, and attributes). Table 1 shows the linkages between these basic system characteristics and their ecological and economic counterparts. Depending on the circumstances, it would be necessary to place a value on either the stock or the flow of services. For example, a standing forest is a stock of trees, while the harvest of timber from the forest represents a service flow.

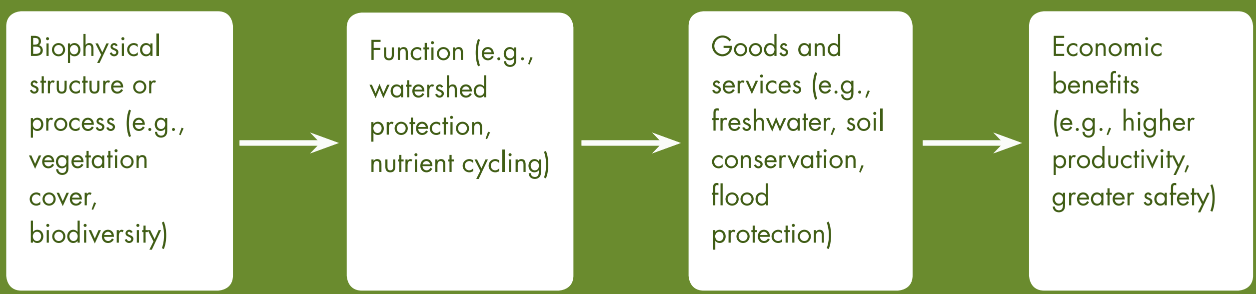
Table 1: **Ecological and economic concepts and their inter-linkages**

System concepts	Ecological concepts	Economic concepts
Stocks	Structural components	Assets
Flows	Environmental functions	Services
Organisation	Biological and cultural diversity	Attributes

adapted from Barbier (1999)

Structural components of ecosystems consist of both living and non-living elements that interact. The interaction of structural components in conjunction with solar energy produces environmental functions such as hydrological functions, nutrient cycling, energy flows (production), climate regulation, and so on (Aylward and Barbier 1992:35). When the structural components of ecosystems are appropriated for use, for example, when trees are used for fuel, or fish and meat are used for food, economists call them 'goods'. Environmental functions that produce benefit flows over time are economic 'services' to society, for example when mangroves help to control floods, vegetation cover helps to protect watersheds, marshes retain sediments, or forests provide nutrient cycling. Goods and services are tangible and intangible outputs, and the attributes indicate how the different components are organised and their level of interaction and functioning (Aylward and Barbier 1992). These linkages are shown in the schematic diagram in Figure 1.

Figure 1: **Biophysical structure, function, goods and services, and economic benefits**



Source: Adapted from TEEB (2010)

The ecological inputs should be valued in the same way as other inputs in the production process such as labour and capital (Polasky and Segeson 2009). For example, the quantity and quality of a forest can be considered as an input to agricultural productivity since forests contribute to nutrient cycling in mountain areas. Similarly, the quantity and quality of wetlands should be taken as an input to fisheries.

These examples show that an integrated framework combining both ecological and economic models is required for the valuation of ecosystem services.

Classification of Ecosystem Values

To place an economic value on ecosystem service benefits (or costs), it is first necessary to define what goods or services are being valued. There are two different approaches for assigning value: anthropocentric and ecocentric or biocentric. An anthropocentric approach defines the value of an ecosystem in terms of its ability to serve human beings. In other words, ecosystems have only 'instrumental' value in so far as they serve a purpose for mankind. The ecocentric or biocentric approach takes the view that all living organisms have 'intrinsic' value that is independent of their instrumental value to serve human beings (Brown, 1994; National Academy of Sciences 2005; UK National Ecosystem Assessment 2010; Bateman et al. 2010).

There are a multitude of views, definitions and classification schemes for ecosystem services (Costanza et al. 1997; Daily et al. 1997; MA 2005).

To capture all the ecosystem services, economists have developed a framework for 'total economic value' (Pearce and Turner 1990). In this, the benefits derived from these services are grouped into two broad categories: 'use values' and 'non-use values' (Figure 2). Use values are further subdivided into direct use values, indirect use values, and option values. Direct use values are those that derive from both the consumptive uses of ecosystem goods and services (such as food, fibre, fuelwood, and medicine) and the non-consumptive uses (such as satisfaction and recreation). Indirect use values are those that arise from indirect ecosystem support in production, regulation, and supporting services, such as nutrient cycling, climate regulation, hydrological recycling, and flood control. Option values are those that are associated with maintaining the availability of certain ecosystem services with the awareness that it is difficult to accurately anticipate future demand for such resources. Non-use values are commonly divided into existence values and bequest values. Existence values derive their economic worth from the fact that people appreciate knowing that certain ecosystems resources exist, even if they have no intention of actually using them. Bequest values are related to the satisfaction that people derive from ensuring the continued existence of ecosystem resources for future generation (Swinton et al. 2007).

In the last few decades, economists and natural scientists have attempted to develop a common interdisciplinary approach to valuing ecosystem services, the most well-known of which has been the Millennium Ecosystem Assessment (MA). While the MA has made a significant contribution to enhancing awareness of the value of ecosystems, it has also created ambiguity by categorising ecosystem goods and services under the single category of 'services' – as opposed to the more common economic nomenclature of 'goods and services' (Figure 3). The main difference lies in the fact that the MA aggregates the main function-based economic values provided by a given ecosystem.

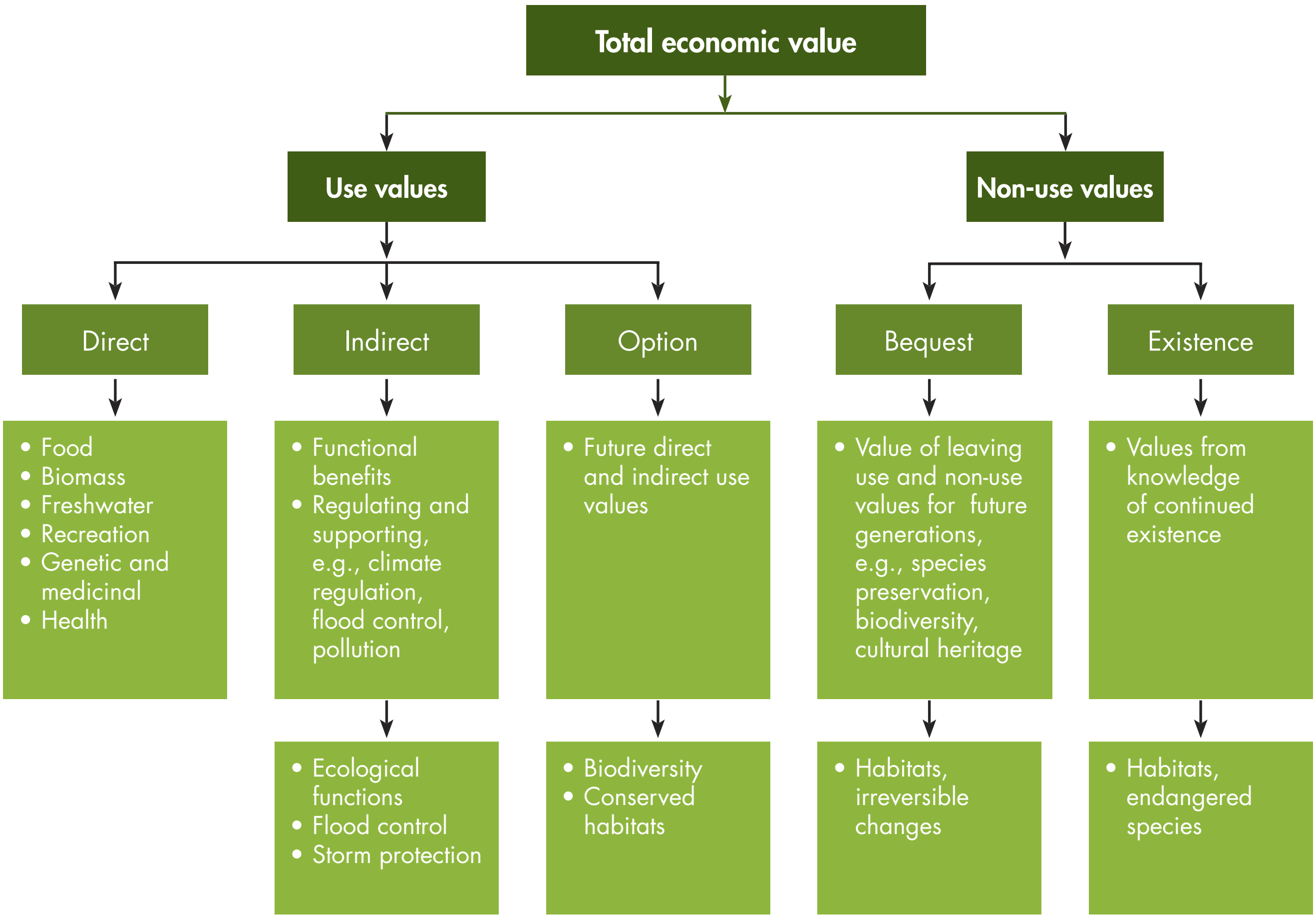


Figure 2: **Types of ecosystem values, the total economic value framework**

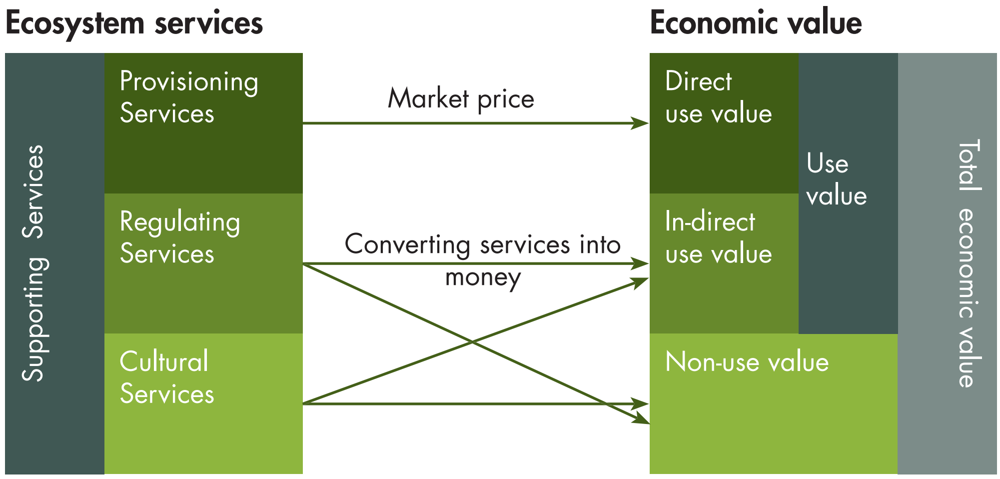


Figure 3: **Integrating ecological and economic approaches** (adapted from MA 2005)

Methodological Approaches to Valuation

Many approaches have been used to define and describe ecosystems and estimate their economic value. Estimating direct-use values is relatively straightforward and relies on existing market prices. It is more challenging, however, to assign a monetary figure to indirect use values (e.g., regulating and supporting services such as climate regulation, water purification, flood moderation, disease regulation, watershed protection, and nutrient cycling) and non-use values (e.g., the value of maintaining the ecosystems for future generations, and the value of the continued existence of the ecosystem) that are not market-traded commodities.

Over the last several decades, economists have developed methodologies to evaluate the intangible benefits of ecosystem services that do not have explicit market values. The valuation methods tend to fall into one of two types: revealed preference and stated preference methods (Boxall et al. 1996; Bräuer 2003; Rasul 2009). Table 2 provides a summary of a selection of tools appropriate for use in the valuation of mountain ecosystems.

The revealed preference method uses information about a marketed commodity to infer the value of a related, non-marketed commodity through a complementary (surrogate or proxy) market. In this case, they use surrogate markets for ecosystem services to estimate monetary value based on indirect use values. An example of a revealed preference approach would be the measurement of the economic value of noise nuisance as reflected in house prices: houses in noisy areas are likely to be cheaper than comparable houses in quieter but otherwise similar areas. Inferred values are calculated from data on behavioural changes in genuine markets using the actual purchase and consumption of marketed goods and services that are variously related to the items for which there is no market. The most common techniques for assessing revealed preferences are replacement costs (the cost of replacing a service with a human-made system); changes in productivity; costs of illness; avoided costs (costs that would be incurred if the service were absent); hedonic prices and estimates of the value of non-market goods and services determined by observing behaviour in the market for related goods and services (e.g., change in the value of real estate with a change in environmental attributes); and travel cost methods (de Groot et al. 2002, Paccagnan 2007).

Stated preference methods are based on hypothetical constructed markets, i.e., they ask people what economic value they attach to a particular environmental attribute. In other words, the economic value is revealed through a hypothetical or constructed market based on a survey. Stated preference methods estimate the monetary value of ecosystem services by asking how much money people would be willing to pay for a particular service or how much they would be willing to accept as compensation if the service were to be eliminated (Boxall et al. 1996; Birol et al. 2006). The two primary types of stated preference methods are the contingent valuation method (CVM) and conjoint analysis. The CVM is useful for estimating the value of goods and services that have neither explicit nor implicit prices and is the most commonly used of the two options. Conjoint analysis is conceptually similar to CVM, but it asks respondents to rank alternatives rather than to make direct statements relating to value (Arifin et al. 2009). The box provides some examples of applications of contingent

Table 2: **Methods, approaches, and their applicability in valuation of Himalayan ecosystem services**

Methodology	Approach	Applicability to Himalayan ecosystems	Examples of applications	Data requirements	Limitations
Revealed preference					
Change in productivity or production function	Trace the impact of change in ecosystem services in production	Suitable for valuation of various ecosystem services, e.g., freshwater (quantity, quality, filtration), wildlife habitat, wetland services; any impact that affects produced goods	Estimating the value of pollination services and assessing how it impacts fruit production in the Himalayas by comparing to changes in these services; or estimating the impact of deforestation on soil nutrient content by estimating changes in crop productivity	Change in services, impact on production or services	Data on change in service and consequent impact on production Does not account for non-use value
Replacement cost	Use cost of replacing the lost goods or services	Can be applied in different mountain contexts, e.g., estimating the cost of replacement, restoration, and relocation for degraded watershed resources and their related goods and services	Estimating the replacement cost for soil nutrients lost due to soil erosion in a mountain watershed, or the cost of restoring a degraded watershed for ecosystem services	Extent of loss, cost of replacement	Tends to overestimate actual value Cannot capture non-use value
Hedonic pricing	Assess the effects of environmental factors and quality on price	Scenic beauty, air quality, and so on	Estimating differential property values due to variation in environmental attributes of different environmental qualities such as scenic beauty, fresh air, less pollution	Prices and characteristics of goods	Requires vast quantities of data Cannot capture non-use value
Travel cost	Derive demand curve from data on actual travel costs	Estimating the monetary value of recreational, religious, and culturally important places	Estimating the time and money spent to use a mountain site for recreation, cultural, or religious purposes	Survey to collect monetary and time costs of travel to destination, distance travelled	Limited to recreational, cultural, and religious services Cannot capture certain non-use values
Averting behaviour, also known as preventive expenditure or defensive expenditure	Estimate the monetary value for an environmental good or service by observing the costs individuals incur to avoid its loss	Estimating the monetary value of watershed services such as soil erosion, nutrient loss, hydrological services, and so on	Estimating the monetary value of buying water filters to assure safe drinking water due to watershed degradation or water pollution	Data requirements for costs of alternative options and market prices	Does not account for non-use value
Stated preference					
Contingent valuation method (CVM)	Ask respondents about their 'willingness to pay' or 'willingness to accept' for a particular ecosystem service	To estimate use and non-use value of different ecosystem services such as biodiversity, mountain landscape, watershed services, hydrological services, natural hazard and flood moderation services, cultural, aesthetic and religious services, and so on	Hypothetical markets can be created to elicit individuals' willingness to pay for conservation of particular ecosystem services, for different environmental attributes, ecosystem service flow level, quality, and so on	Survey that elicits 'willingness to pay' or 'willingness to accept' for specified services. Requires expertise in designing surveys, sampling procedures, and data analysis	Potential sources of bias in responses; in hypothetical questions, respondents do not face actual situations, so their stated preferences may be different from those in a real situation Can be used to estimate both use and non-use values
Group valuation or discourse-based valuation	Asks a group of stakeholders to assess the value of ecosystem services	A non-monetised participatory, qualitative method; used to rank the value of different complex ecosystem services from the stakeholders' perspective	Used in participatory valuation of ecosystem services where other economic tools cannot be applied	Several rounds of consultations	Difficult to reach a convergence value Requires careful facilitation to prevent domination of the final values by specific interest groups

Examples of Economic Valuation from the Himalayas

Empirical studies on willingness to pay using contingent valuation methods

Very few empirical studies have been conducted in the HKH region on willingness to pay (WTP) in order to make an economic valuation of the services provided by biodiversity. Existing studies focus on the recreational and aesthetic value of protected areas (Maharana et al. 2000a,b; Baral et al. 2008) and have assessed the willingness to pay for the conservation, maintenance, and enhancement of biodiversity resources using contingent valuation.

Maharana et al. (2000a) surveyed local communities and domestic and foreign visitors to estimate the environmental value of the Khangchendzonga National Park in Sikkim (India) and to elicit their willingness to pay for its maintenance and conservation. Using a random sample, the average willingness to pay for improvements in environmental conservation was US$ 8.84 per foreign visitor per visit, US$ 6.20 per household per year for the local community, and US$ 1.91 per domestic visitor per visit.

In 2006, Baral et al. (2008) conducted contingent valuation surveys of 315 foreign visitors to the Annapurna Conservation Area (Nepal). Results suggested that most visitors would be willing to pay an entry fee considerably higher than the current fee of US$ 27. The mean and median willingness to pay were US$ 69.2 and US$ 74.3, respectively. Based on this analysis, the studies recommended an increase in the entry fee to US$ 50.

Application of cost benefit analysis in economic valuation of ecosystem services in India

Badola et al. (2010) examined the economic value of selected ecosystem services such as the provisioning of biomass for fuel, recreation, carbon sequestration, nutrient cycling, and catchment area protection for hydropower in the Corbett Tiger Reserve in Uttarakhand (India). The authors valued the service using cost benefit analysis, where the direct cost was derived from secondary sources and the indirect and opportunity costs were valued through socioeconomic surveys. The 'individual approach to travel cost' method was used to estimate the recreational value, and the replacement cost method was used to assess carbon sequestration. The maintenance cost of the reserve was estimated as US$ 2,153,000 per year, with indirect costs in terms of crop and livestock depredation by wild animals ranging from US$ 2,408 to US$ 37,958 per village over a period of five years. The total value of dependence of local communities on products was assessed for fuelwood (US$ 7,346 per day), and fodder (US$ 5,290 per day). Bhabhar (*Eulaliopsis binata*), a seasonal grass, was extracted in summer, and value added by local people by making it into rope, from which they gained US $12 per 100 kg. The recreational value of the reserve was estimated at US$ 167,619 per year. The cost per visitor was US$ 2.5, thus the consumers' surplus was large, showing the willingness of visitors to pay for wildlife recreation. The forests of the reserve sequester carbon worth US$ 63.6 million, with an annual flow of US$ 65 per ha per year. The other benefits of the reserve include a total of US$ 41 million through the generation of electricity since 1972. The authors used these results to argue that the valuation of services derived from natural resources can be used to make a convincing case for the conservation of ecosystems.

Application of CVM method in economic valuation of urban biodiversity conservation in China

Chen and Jim (2010) analysed the motivation of Guangzhou's residents and their willingness to pay for an urban biodiversity conservation programme in the National Baiyun Mountain Scenic Area (China). The peri-urban natural site, which offers refuge to some endemic species, is under increasing development pressure for recreational and residential use. These investigators used the contingent valuation method (CVM) to assess the non-market value of the urban biodiversity conservation programme, and also probed residents' attitudes on environmental issues, their motivation for urban nature conservation, and their willingness to pay for biodiversity conservation. They distributed a questionnaire and interviewed 720 people face-to-face in a stratified sample household survey. The median willingness to pay was estimated at RMB 149 per household per year (about US$19.5) and an aggregate of RMB 291 million annually (approximately US$ 38.2 million) to support the urban conservation project. Including public motivation into contingent valuation presents a promising approach to conduct cost benefit analysis for public projects in China. The authors conclude that the monetary assessment of biodiversity measures the welfare damage brought about by biodiversity loss, and cost-benefit analysis of conservation projects in a socioeconomic context and the contingent valuation method could include motivational factors to strengthen the economic analysis of nature conservation.

valuation methods to assess the economic value of specific ecosystem services in different parts of the HKH region. Various techniques are used to elicit the value of non-market goods and services. The most commonly used techniques are the bidding game, payment card, and open-ended and dichotomous choice (Boyle et al. 1998; Boyle 2003). These methodologies, though fairly well developed, are still not used widely due to limitations on the estimation to capture the values of non-marketed ecosystem services.

In the stated preference methods, special care needs to be taken in the design of questions and in the selection of the appropriate approach. There is a possibility of bias in willingness to pay that reflects the fact that the value of environmental services is appreciated differently by producers and consumers. When the supply of environmental services is less than socially optimal, it is advisable to estimate the value from the producers' willingness to supply those services known as 'willingness to accept' (WTA) rather than from the standpoint of the consumers' willingness to pay (Swinton et al. 2007). Generally, willingness to pay is appropriate when beneficiaries have no ownership over the resources or services, such as, for example, better hydrological services received by downstream communities. Willingness to accept is appropriate when beneficiaries own the resources in situations where the service levels are being reduced, such as farmers conserving biodiversity in farmland in mountain areas. Willingness to accept may often outweigh the willingness to pay.

Both stated and revealed preference methods have advantages and disadvantages. The revealed preference method has a higher general acceptance as values are estimates based on certain physical parameters or data, and these approximations engender greater confidence than data generated by interviews about a hypothetical situation (Paccagnan 2007). With hypothetical questions, stated preferences may differ from a real situation (Diamond and Hasuman 1994; Paccagnan 2007). It is, however, not always possible to get a physical reference point, or proxy indicator, when estimating non-use values. This problem emerges, for example, when estimating decreased agricultural productivity due to increased soil erosion, or declining property values due to deteriorating environmental quality. When no surrogates are found, the stated preference method is the only option (Boxall et al. 1996). The choice of valuation methods, therefore, depends upon the nature of the goods and services, and/or the type of benefits that are being measured. Recent approaches to improve estimation combine revealed and stated preference methods (Paccagnan 2007), and a few recent empirical studies use both methods (e.g., Whitehead et al. 2000; Andersson 2007).

Application of Economic Tools in the Valuation of Himalayan Ecosystem Services

Economic tools have been used extensively in recent years and there is a growing literature on their application. Table 2 presents some of the economic tools suitable for use in valuations of mountain ecosystem services, together with their data requirements and limitations.

Process of Economic Valuation

The process of economic valuation begins with a scoping exercise in which the goods and services to be evaluated from a particular ecosystem or landscape are identified; this is followed by application of appropriate methods and techniques for capturing their use and non-use values. The process of valuation ends with a policy appraisal, understanding the drivers of change, and identifying the course of action to arrest the degradation and improve the health of the ecosystem. Figure 4 briefly presents the key stages and processes of ecosystem valuation and the corresponding issues and guidelines. A checklist to guide an economic valuation study is provided in the Annex.

Limitation of Economic Valuation

Economic valuation cannot value everything; not all benefits provided by ecosystems are fully translatable into economic terms. The damage suffered by ecosystems can be non-linear; and the impact of changes in ecosystems can be much higher or irreversible above certain thresholds. Methodological limitations constrain the extent to which economic valuation methods can capture the ecological interdependencies of different ecosystem entities. As a result, valuation analysis often ignores, or does not adequately account for, the internal structure of ecosystems, and the interdependencies and inter-linkages of different ecosystem entities. Moreover, by relying on revealed or stated preferences, the economic valuation methods are not able to capture normative and ethical aspects of ecosystems. Thus economic valuation remains an indication of the value of an ecosystem rather than an actual value.

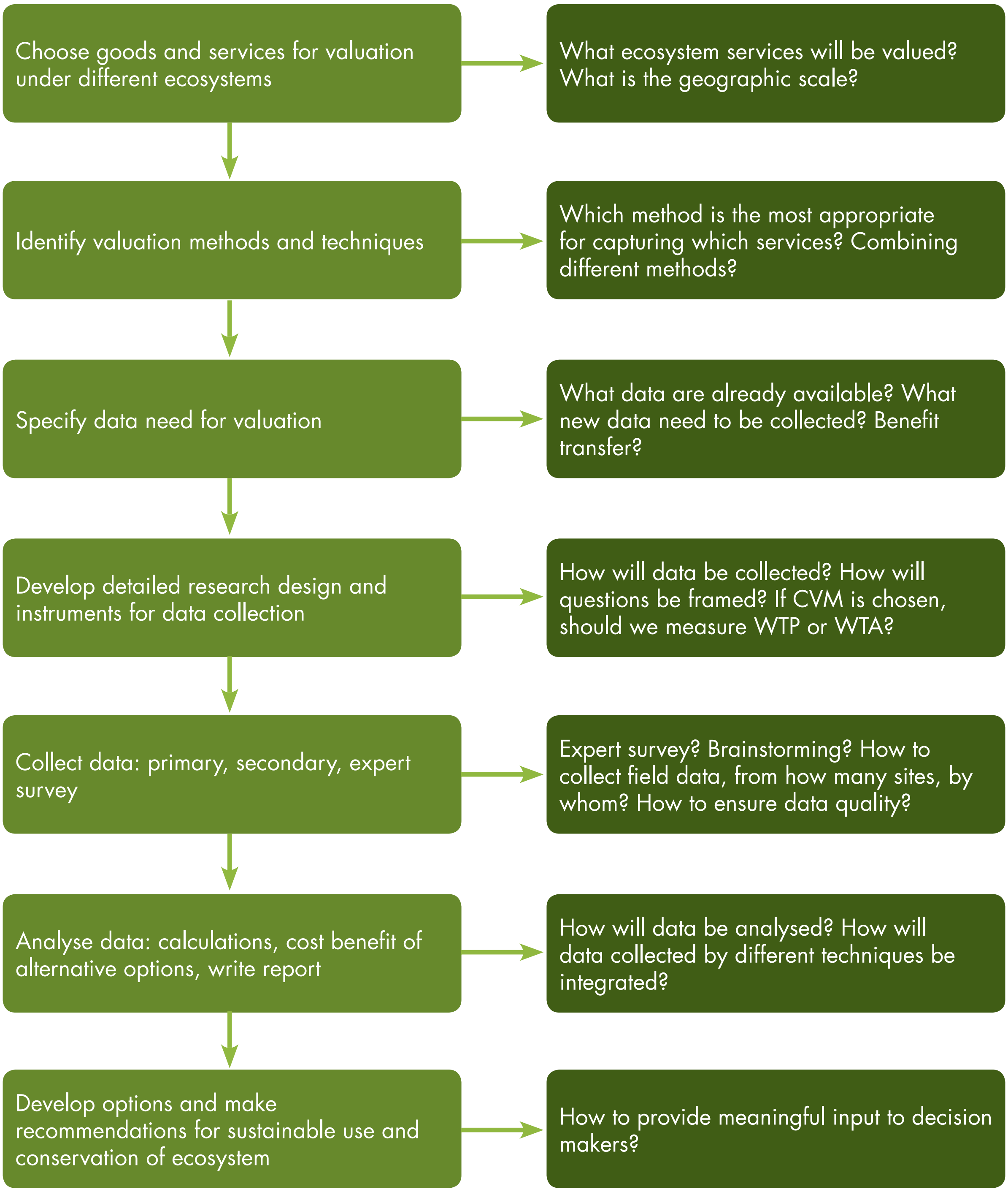


Figure 4: **Key stages and processes of ecosystem valuation**

Economic valuation may help to inform management decisions, but is only useful when decision-makers then take appropriate action for conservation. The aim of the economic valuation should be to identify a more cost effective and efficient course of action for the conservation of ecosystems that will maximise human wellbeing. Valuation is one element in the effort to improve the management of ecosystems and their services, but is in itself not sufficient. Other supporting elements are all vitally important for the effective conservation and management of resources with justice and equity, these include strong institutions and governance mechanisms, group or multi-stakeholder efforts, and sound policy. More importantly, the valuation of ecosystem services has to be context and ecosystem specific, in order to inform the policy decision.

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Annex: Checklist to Guide Economic Valuation of Ecosystem Services

The valuation exercise is context specific – a given method or technique is not necessarily applicable in all cases. Methods and techniques need to be customised and adapted to suit the situation at hand. Different methods may need to be pulled together to achieve the desired goal. The geographic and temporal scale of the analysis should be consistent with the scale of the impacts. However, extrapolations across space (from one ecosystem to another), time (from present impacts to future impacts), or scale (from small changes to large changes) should be executed very carefully to avoid possible errors. Special care is also needed to handle temporal, spatial, and inter-personal tradeoffs as overexploitation of an ecosystem by the present generation may jeopardise its usefulness for future generations. It is important to remember that local people often have to bear the costs of conservation, whereas the benefits often go to the national, regional, and global community. Therefore, it is important to look at the distributional aspects of ecosystem management such as who is bearing the cost of conservation, who is receiving the benefits, and how can the mountain ecosystem managers be compensated or rewarded.

The following checklist can be useful in designing economic valuation studies.

1. What is the purpose of the valuation exercise?
   - What is the policy decision that needs to be made?
   - What information is needed to answer the policy question?
   - How will the valuation results be used?

2. What is the scope of the valuation exercise?
   - What ecosystem services will be valued?
   - Is it necessary to value only one or several ecosystem services?
   - Is it necessary to value all services?

3. What is the appropriate geographic scale of the valuation exercise?
   - Is it a local, national, or regional analysis?
   - What is the relevant population to include in the value estimates (i.e., whose values need to be taken into consideration)?

4. How is the valuation question framed?
   - Does the question measure WTP or WTA as a measure of value? Is the question framed in terms of losses or gains?
   - What effect is framing likely to have on the valuation estimates? Is it likely to introduce systematic biases? What effect would alternative frames be likely to have on the value estimates?
   - What are the advantages and the limitations of the frame that is chosen?
   - Is the frame responsive to stakeholder needs and will it generate information useful to the stakeholders?

5. What valuation methods/techniques are available for the services to be valued?
   - Different valuation techniques may measure different things. Which seem most appropriate?
   - To what extent is integrated ecological-economic modelling required to capture the value of the multiple services, and the 'interconnectedness' between the structure and functioning of the ecosystem and the services of value generated?
   - For any given method, which services are captured in the estimated values and which are not?
   - Whose values are captured by the method?

6. What data are needed?
   - Are original values to be generated, or are estimates of values from previous studies to be used ('benefit transfer')?
   - If benefit transfer is to be used, how transferable are the available estimates to the ecosystem services of interest?
   - If original estimates are to be generated, what is the appropriate sample to be used in gathering data?
   - How will the sample choice affect the valuation estimates?
   - Has the quality of the data been evaluated adequately?

7. How is aggregation handled?
   - Do benefits/values extend over time?
   - Is discounting, a mechanism which converts a future value to a present value, used to aggregate over time? If so, what discount rate is used?
   - How are values aggregated across services?
   - If estimates derived by different methods are combined, is there a potential for double counting of the same variable? What steps have been taken to avoid double counting?

8. How will the valuation findings be linked to policy decisions?
   - How do policies affect the conservation of the ecosystem being valued?
   - How do conservation and changes in ecosystem service flows affect the welfare of the key stakeholders?
   - What policy and economic instruments can be used to manage these services equitably and efficiently?

Glossary of Important Terms

Contingent valuation (CV) – An economic valuation technique based on the stated preference of respondents as to how much they would be willing to pay for specified benefits. A detailed description of the goods or service involved is given, together with details on how it will be provided. CV is designed to circumvent the absence of markets by presenting consumers with hypothetical markets in which they have the opportunity to buy the goods or service in question.

Cultural services – The non-material benefits people enjoy from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experience, including, for example, as a place to acquire knowledge and for social interaction.

Discourse-based valuation – Discourse-based valuation is a method whereby groups develop consensus values or prioritise multiple entities. In this process, stakeholders depict a complex environmental issue in terms of the common-sense values and attributes by which potentially-affected people think about the problem and bridge the gap between the quantitative, impacts-driven perspective of the technical expert and the more qualitative, values-driven perspective of the concerned citizen. Depending on the metric being used, this ordering can utilise continuous, discrete, or nominal scales.

Direct use value – In the total economic value framework of an ecosystem, the benefits derived from the goods and services that are used directly by an economic agent. These include consumptive uses (e.g., harvested goods) and non-consumptive uses (e.g., enjoyment of scenic beauty).

Ecosystem – A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit.

Ecosystem approach – A strategy for the integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way. An ecosystem approach is based on the application of scientific methodologies at the level of biological organisation; it encompasses the essential structure, processes, functions, and interactions between organisms and their environment. It recognises that humans are an integral component of many ecosystems.

Ecosystem boundary – The spatial delimitation of an ecosystem, typically based on discontinuities in the distribution of organisms, the biophysical environment (soil types, drainage basins, depth in a water body), and spatial interactions (home ranges, migration patterns, fluxes of matter).

Ecosystem function – An intrinsic ecosystem characteristic related to the set of conditions and processes whereby an ecosystem maintains its integrity (such as primary productivity, food chain, and biogeochemical cycles). Ecosystem functions include processes such as decomposition, production, nutrient cycling, and fluxes of nutrients and energy.

Ecosystem services – The benefits that people obtain from ecosystems. These include provisioning services such as food and water; regulating services such as flood and disease control; cultural services such as spiritual, recreational, and cultural benefits; and supporting services such as nutrient cycling, that maintain the conditions for life on Earth. The concept 'ecosystem goods and services' is synonymous with ecosystem services.

Existence value – The value that individuals place on knowing that a resource exists, even if they never use that resource (sometimes also known as conservation value or passive use value).

Hedonic price methods – Economic valuation methods that use statistical techniques to break down the price paid for goods and services into the implicit prices for each of their attributes, including environmental attributes such as access to recreation or clean air. For example, the price of a home may be broken down to see how much the buyers were willing to pay for it in a neighbourhood with cleaner air.

Indirect use value – The benefits derived from the goods and services provided by an ecosystem that are used indirectly by an economic agent. For example, an agent at some distance from an ecosystem may derive benefits from drinking water that has been purified as it passed through the ecosystem.

Non-use value – The benefits which do not arise from direct or indirect use.

Opportunity cost – The foregone benefits of not using land/ecosystems in a different way, e.g. the potential income from agriculture when conserving a forest.

Option value – The value of preserving the option to use services at a future date either by oneself (option value) or by others or heirs (bequest value). Quasi-option value is the value of avoiding irreversible decisions until new information determines whether certain ecosystem services have values of which society is not currently aware.

Production function (PF) approach – The production function approach values the ecosystem as an input to production. It assumes that an ecosystem good or service is an input in the production of a marketed useful good. Thus, changes in the availability of the ecosystem good or service can affect the cost and supply of the marketed good, the returns to other factor inputs, or both.

Provisioning services – The products provisioned by ecosystems, including, for example, genetic resources, food and fibre, and freshwater.

Regulating services – The benefits obtained from the regulation of ecosystem processes, including, for example, the regulation of climate, water, and some human diseases.

Replacement cost – An approach to valuing ecosystem services that uses the cost of replacing them: either the cost of restoring the ecosystem to a state where it once again provides the service, or the cost of obtaining the same service in some other way.

Supporting services – Ecosystem services that are necessary for the production of all other ecosystem services. Some examples include biomass production, production of atmospheric oxygen, soil formation and retention, nutrient cycling, water cycling, and provisioning of habitat.

Threshold – A point or level at which new properties emerge in an ecological, economic, or other system, invalidating predictions based on mathematical relationships that apply at lower levels. For example, the species diversity of a landscape may decline steadily with increasing habitat degradation up to a certain critical threshold of degradation after which they then decline sharply.

Travel cost method – An economic valuation technique that uses the observed costs to travel to a destination to derive demand functions for that destination. There are two approaches to travel cost methods – the individual travel cost model and the zonal travel cost model. The individual travel cost model estimates the value of a recreational site by developing the individual's recreation demand function; whereas the zonal travel cost model estimate the aggregate or market demand function for a recreational site using statistical techniques. Travel cost methods have limited applicability outside this context.

Total economic value – A framework for considering various constituents of value, including direct use value, indirect use value, option value, quasi option value, and existence value.

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The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush-Himalayas – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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