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TECHNICAL REPORT

Maximize the production of goods and services of Mediterranean forest ecosystems in the context of global changes

June 2016

Assessment of the socio-economic value of the goods and services provided by Mediterranean forest ecosystems

Regional synthesis

Technical report

Assessment of the socio-economic value of the goods and services provided by Mediterranean forest ecosystems: critical and comparative analysis of studies conducted in Algeria, Lebanon, Morocco, Tunisia and Turkey

This report is the result of work conducted by Plan Bleu and the Secretariat of Comité Silva Mediterranea (FAO) as part of the "Optimizing the production of goods and services by Mediterranean forest ecosystems in a context of global changes" project, funded by the French Global Environment Facility (FFEM) for the period 2011 to 2016.

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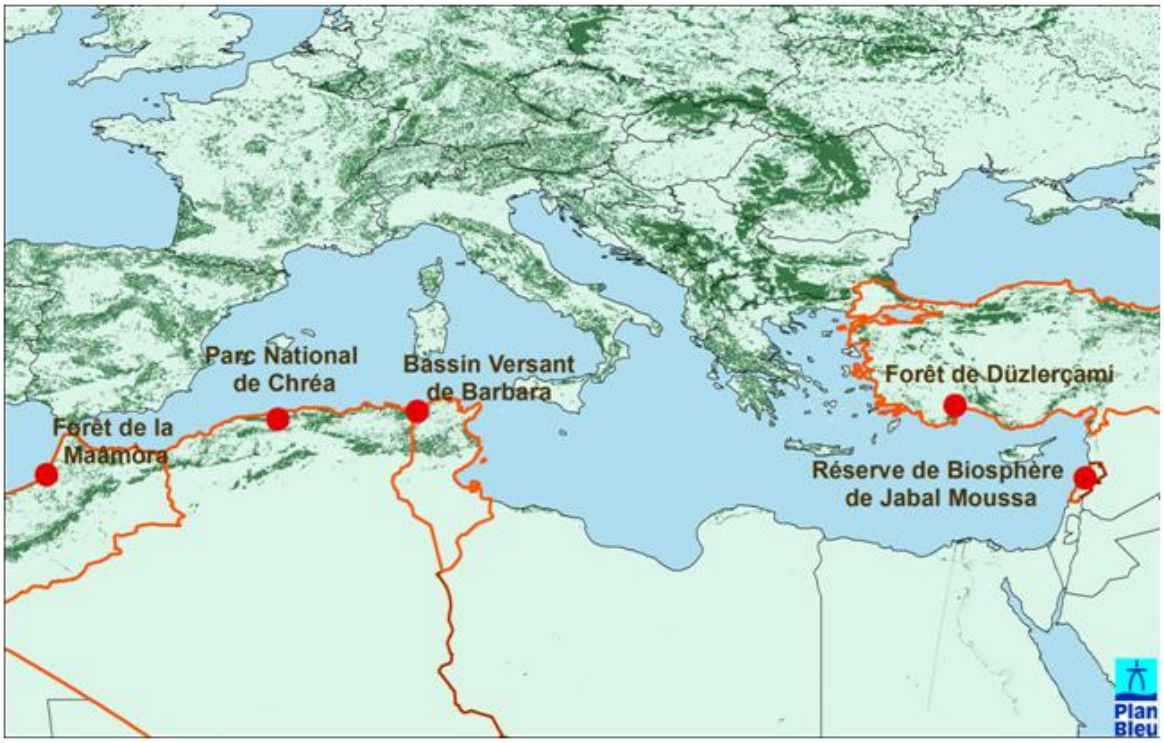
Introduction

This study is part of the project conducted by the FAO Committee on Mediterranean Forestry Questions - *Silva Mediterranea,* funded by the French Global Environment Facility (FGEF), entitled "Optimising the production of goods and services by Mediterranean forests in a context of global changes". Economic valuation is one of the five focus areas adopted as the project's priorities:

- Component 1 (C1): Integrate the impacts of climate change into forestry management policies and produce data and tools regarding both the vulnerability of forests and their ability to adapt.;
- **Component 2 (C2): Assess the socio-economic values of goods and services provided by Mediterranean forest ecosystems.**
- Component 3 (C3): Improve modes of governance for Mediterranean forest ecosystems at a territorial level.
- Component 4 (C4): Optimise and value the role of Mediterranean forests in climate change mitigation (carbon sinks), via the production of methodological tools.
- Component 5 (C5): Promote coordination and sharing of experience between Mediterranean stakeholders via the Collaborative Partnership on Mediterranean Forests (CPMF).

The project's partner countries are Algeria, Lebanon, Morocco, Tunisia, and Turkey. The forests of these countries contribute to combating poverty, the socio-economic development of rural areas, food security, and cultural and recreational heritage. However, these studies are important because forest management strategies do not necessarily seek to optimise the value of forest goods and services, whether locally by local users, nationally by other economic sectors that benefit from them, or internationally by international carbon credit funds.

Figure 1: Location of the pilot sites selected for Component 2 of the FGEF Project



These studies have been implemented in four pilot sites: Chréa National Park in Algeria, Jabal Moussa Biosphere Reserve in Lebanon, Maamora Forest in Morocco, and Düzlerçami Forest in Turkey. For a more comprehensive regional approach, the results from the prior economic valuation of the goods and services of the Barbara Catchment Area in Tunisia have been incorporated into this report (Daly et al. 2012). Table 1 presents the specific contexts and weaknesses for each site.

Using each of the national study reports, this report attempts to analyse the methods, their implementation and the results obtained to evaluate the various services of the sites studied, and compares them with previous studies. Finally it presents conclusions and lessons learned for economic valuation on a regional scale.

Table 1: Specific features of the pilot sites

Country	Pilot site	Woodland area (ha)	Dominant forest species	Main functions	Main weaknesses	Goods and services used for the economic valuation		
						Provisioning goods	Regulation services	Cultural services
Morocco	Maamora (State land)	126,200	Cork oak	Production of wood and other products for the local population Recreation, etc.	Weakened ecosystem from drought and human pressures	Wood Fodder Cork Other NTFP[1]		Recreation
Algeria	Chréa National Park (State land)	22,673	Atlas cedar, oak, etc.	Conservation of biodiversity (Biosphere reserve) Recreation	High management costs Risk of damage and pollution from excessive visitors	Arbutus berries	Water purification	Recreation
Tunisia (outside of C2 studies)	Barbara Catchment Area (State land)	5,065	Cork oak	Cork production Pastureland Protection of the dam from sedimentation	Human pressure on forest resources	Cork Fodder Other NTFP	Protection against sedimentation	
Lebanon	Jabal Moussa (municipal and religious-owned land)	5,500	Oak, Turkish pine, etc.	Conservation of biodiversity (Biosphere reserve) Recreation	Loss of earnings for locals following usage restrictions	Thyme Fodder Nectar		Recreation
Turkey	Düzlerçami (State land)	17,688	Turkish pine	Wood production Protection of biodiversity Recreation	Increase in recreational demand Negative impacts from climate change	Wood	Carbon sequestration	Recreation Protection of biodiversity

[1] NTFP = Non-Timber Forest Products

Value of forest goods and services provided by forest ecosystems

Forests in Southern and Eastern Mediterranean Countries (SEMCs) are often characterised by their public land (State, Municipal, religious-owned) and by the diversity of goods and services used (firewood, fruit, pastureland, etc.). In Maghreb countries, the State manages forests but the local populations often have use rights. However, there is considerable use of forest resources (pastureland, fruit and mushroom picking, honey production) that is not always legal (overuse, unregulated use, etc.), which often leads to stronger pressures than forest or sylvo-pastoral ecosystems are able to withstand in the context of sustainable management. Because resources are shared, local households seek to meet their subsistence needs and increase their short-term income with little interest in using resources sustainably or in the long-term effects of over-use. There is therefore a need to create a balance between uses, pastureland and forest conservation. Benefit distribution varies depending on use rights and the type of products provided by forest ecosystems.

In general, economic valuation studies of ecosystems in SEMCs are rare. The pilot sites in different countries have been chosen in order to study diverse Mediterranean ecosystems (cork oak, pine, etc.) (see Table 1), and assess various goods and services such as fodder, Non-Timber Forest Products (NTFP) and the protection of catchment areas, which are considered as the main benefits in the region (Merlo et Croitoru, 2005). The decision to assess recreation as a service (which has been relatively unexplored to date) for several sites shows its contribution to the economic value of forests in various countries.

This section summarises the assessments conducted by national experts in the pilot sites[2] of the FGEF project as well as a study done in another context in Tunisia.

CRITICAL ANALYSIS OF METHODS USED[3]

Environmental economic literature provides a wide selection of methods and techniques for valuating ecosystem services (Plan Bleu, 20154; Plan Bleu, 2014, Brahicet Terreaux, 2009; World Bank, 2005; Bishop (Editor), 1999; Merlo M., Croitoru L. (Eds.), 2005; Daly, 2013; TEEB (2010)).

This section presents the methods and techniques used for estimating the value of goods and services in the different sites and discusses their specific implementation for the valuation of forest goods and services. The valuation methods vary between approaches based on revealed preferences (observations of the current behaviour of consumers in goods and services of interest such as market price, or substitute markets) and approaches based on expressed preferences (willingness of consumers to pay for a benefit) (Table 2). Estimates based on observed behaviour are generally preferred over those based on assumed behaviour (CAS, 2009), and direct measurements are better than indirect measurements (Merlo and Croitoru 2005). However the choice of method depends on the characteristics of the case study and available data. The benefit transfer method must also be used with caution when sites have similar characteristics. In general, regulation services are more difficult to assess than provisioning products.

The methods are discussed below in detail for each good or service[5].

Wood and Non-Timber Forest Products (NTFP)

National assessments used the same market price-based approach to assess the value of these products. The price should be the local price and not include operating costs, transport, market or processing costs. However, the availability of and access to data on quantities traded and the market price prevent it from being applied. Calculation assumptions were developed (i) for Morocco, taking into account the wood production mean for the 2004-2014 period and mean prices for 2010-2014 in order to take into account annual volume variations and price fluctuations for a species – these considerations do not give the economic value of the wood for a given year; (ii) for Tunisia, the volume of firewood was estimated based on previous studies; (iii) for Turkey, there is considered to be no firewood harvesting; (iv) for Lebanon, mean wood price

[2] For more information, please refer to the national study reports cited in the bibliography, which can be downloaded from the Plan Bleu website: www.planbleu.org
[3] For more information on economic valuation methods used to assess the value of goods and services, please refer to Appendix 2 of this document
[4] http://planbleu.org/sites/default/files/publications/forest_factsheets_methods.pdf
[5] The national experts could base their studies on a methodological guide produced by Plan Bleu in collaboration with CTFC and EFIMED (PlanBleu, 2014) and a workshop held in Tunis in June 2014. The methodologies developed for each of the pilot sites come from these different tools. During implementation, an economist expert supported the national experts who wished, to help them deploy the chosen methodology and perform calculations.

estimate was used. Furthermore, data concerning the quantity of wood harvested for a given year (Turkey) does not always reflect the wood supplied by forests because actual harvesting depends on the age of the population and the forest exploitation plan.

There is even less available data on NTFP than on wood. Although data on cork quantities and prices are easily accessible, annual quantity and price fluctuations meant experts had to use various assumptions. Data used for Morocco corresponds to a relatively long production cycle of cork oak (77 years), which makes it impossible to obtain an actual indication of the economic value of cork for 2015. For Tunisia, the average production from cork harvesting (over a 12-year rotation) was used. For other NTFP, data based on the expert's knowledge, such as average productivity (Morocco, Tunisia, Lebanon) or data from collector surveys (Algeria) was used, which provides an estimate that is close to reality. Market prices (without subtracting collection costs) were also used by most countries, often resulting in an overestimate. Other overestimates of the value of nectar may be explained by all honey production being attributed to forests when in fact the beehives are moved to the forest for a certain period of the year (Morocco).

Fodder

The substitution price method was used by all the countries. When the market price for a product does not exist, the value of a product can be estimated using substitution products available on existing markets. In this case, the price of barley was used as a substitution product for fodder. One kg of barley is equivalent in energy to one fodder unit. Fodder production depends on climate conditions and grazing practices. In some countries (Morocco) productivity was estimated without taking into account annual variation, or it was based on data provided by a pastoral inventory (Tunisia).

The area of forests actually used for grazing is also difficult to define. In some cases, it is difficult to ascertain whether young plantations closed off to the public (Morocco) were subtracted. For Lebanon, the quantity of fodder was estimated using indicators for the number of goats grazing in forests and daily consumption per goat.

Recreation

The transport cost method is typically used to assess the value of leisure and cultural services, including in Morocco and Algeria. This method takes into account the cost of transport and the number of visitors to the site observed in order to estimate the value of using recreational amenities. The request by an individual to visit a site is often modelled by determining the cost of an excursion to the site as a function of the income and other demographic and financial characteristics of the individual surveyed. The higher the cost of transport to reach the site, the fewer the number of visitors (function of demand). The recreational value is determined based on the consumer's surplus, i.e. the difference between the maximum price that a consumer is willing to pay and the actual price paid. This method requires a survey of visitors, the development of a function related to the number of visits on demand depending on the cost of the visit, and deduction of the surplus that visitors gain from visiting the site, corresponding to the value of the visit. The cost of transport often used is the total cost of the visit, i.e. the sum of transport, the entry cost and the opportunity cost for the time spent on the site.

However, this method can lead to overestimates. For example, in Morocco, catering spending was included in the cost of transport. As this spending accounts for the bulk of the cost, it resulted in a relatively high value per visit (29 Euros per visit to Sidi Amira, the most visited site). In reality, the forest can be visited without necessarily spending money on food, especially since visitors live close to the forest. In this case, if a majority of visitors have little or no travel costs, it is better to use the contingent assessment method in order to predict their real behaviours and conduct a survey on people's willingness to pay for a recreational visit to the forest. For Algeria, the fish model obtained has a few weaknesses due to the fact that the correlation between the number of visits and the cost of the visit was not observed. Despite the reduction in the number of observations in order to eliminate errors, the model is not significant enough as a whole and the correlation coefficient remains low. The figure obtained for the value of the visit is therefore not very reliable.

The recreational value is the result from multiplying the value of the visit obtained by the model and the number of visits for a given year. However, an inventory is not always kept of the number of visits to a site, especially when there is no entry fee. This is the case for Morocco, where the number of visits is estimated at about 600,000 visitors per year, and for Algeria, where the number of people visiting one of the recreational sites was estimated at at least 85,000.

The benefit transfer method was used in Lebanon and Turkey because it is quick and cheap. The method involves applying the values used for one site (willingness to pay) to another site, but only if the site has similar characteristics. However there are differences that can be determining factors in the willingness to pay: socio-economic and demographic characteristics, market conditions, changes over time, etc., as well as the recreational service itself. Although adjustments can be made, this method has weaknesses that are inherent to the approach. The quality of the results also depends on the scientific validity of the original study, the similarities between the original site and the pilot site, and the method used to transfer the values. In addition to the margins of error related to the method used, the number of visitors is often estimated based on the number of vehicles having visited the site.

Protection of water resources

Cost-based methods are often applied to estimate the value of protection services. The replacement cost method gives a value to the environmental benefit by estimating the cost of replacing it with an alternative benefit or service. This method was applied in Algeria to estimate the value of water purification. The damage cost avoided method is based on the assumption that the loss of ecosystem services will generate costs for society in order to avoid the damage caused, which means that the services must be worth at least as much as these costs. This method was applied in Tunisia to estimate the value of protection against sedimentation.

To use these methods, data is required on additional costs that would be incurred if the forest did not exist. This leads to the use of models that estimate the amount of silting of the dam (Tunisia) and valuations of replacement costs (water purification in Algeria, construction of a dam in Tunisia).

Carbon

Carbon sequestration was assessed based on the social value of carbon ($30/t), estimated by the World Bank. This value is based on the external costs of carbon emissions, such as costs for damage to crops and heatwave- and drought-related healthcare costs or property damage from floods and rising sea levels.

Conservation of biodiversity

The contingent valuation method is often used to assess the value of biodiversity. This method uses surveys of the population concerned to directly assess willingness to pay for conservation/improvement of biodiversity. Due to a lack of time, the damage cost avoided method was used in Turkey. The value indicated serves simply as a minimum value indicator. The value of biodiversity conservation must be at least equal to what individuals have paid to avoid losing it.

Table 2: Methods adopted for assessing the value of goods and services in different countries

Type of goods and services	Valuation method	Country
Wood	Market price	Morocco, Tunisia, Turkey, Lebanon
Non-timber forest products	Market price	Morocco, Algeria, Tunisia, Lebanon
Fodder	Price of substitution products	Morocco, Tunisia Lebanon
Recreation	Transport cost method	Morocco Algeria
	Benefit transfer method	Turkey Lebanon
Protection of water resources	Replacement cost method	Tunisia Algeria
Carbon	Social cost of carbon	Turkey
Conservation of biodiversity	Damage cost avoided method	Turkey

COMPARATIVE ANALYSIS OF RESULTS

Common units are required to compare results. To this end, unit values and mean values per hectare are used. The values per hectare of goods and services reflect the main functions of the forest ecosystem and provide an indication of the forest management policy. Some NTFP are harvested from part of the site, depending on existing species. In addition, certain services (recreation) are sometimes developed over a very limited area. For this, mean values for the given area show the importance of the good or service provided in a clearly defined area.

It is difficult to compare values at a national level given the fact that some forests in the chosen sites are productive forests while others are not, and some sites do not necessarily represent the forests of the country. In the analyses below, the mean values for all the forests of the country are taken from the book published by Merlo and Croitoru (2005).

Wood

The value of wood for all the sites is low (with the exception of Morocco (see Table 3). This can be due to low productivity (Tunisia, Lebanon), the reduced exploitation of wood (Turkey) and the quality of wood (Tunisia). The lack of reliable statistical data on firewood consumed by the local population should be highlighted for the various countries. The price of wood in Lebanon remains high, which can be explained by the scarcity of resources. The differences between

the values obtained by the sites and the national values can be attributed to the specific features of the sites, as well as the differences in valuation methods, especially in the case of Morocco.

Table 3: Value of wood in the sites studied (2014)

	Values obtained from the pilot sites				National value
	Production (m3/ha)	Market price (€/m³)	Value (€/ha of forest exploited)	Value (€/ha for entire site)	Value (€/ha of forest) 2001*
Morocco	5.3	15.7	83.4	83.2	20.8
Tunisia	2	5.1	10.4	10.4	4.5
Lebanon	1.2	64.1	78.0	17.7	28.0
Turkey	0.77	33.2	25.5	16.2	23.0

* Merlo and Croitoru, 2005

Fodder

The value of fodder is quite high for the sites studied (Table 4). Forest grazing remains the main source of subsistence for local populations in the countries studied and fodder is essential in silvopasture management. The difference in values between the countries can be explained by the use of resources and prices. There are also likely to be overestimates of potential fodder production for Morocco and Tunisia.[6] Fodder production in Lebanon is estimated based on the number of goats that graze on a site and the consumption per goat (2 Fodder units per day for 4 months). The values obtained directly from the sites should be more precise than national values since they are based on on-site estimates. The difference in value can be explained by the fact that the site is not always representative of the entire country.

Table 4: Value of fodder in the sites studied (2014)

	Values obtained from the pilot sites				National value
	Productivity (Fodder units/ha)	Value (€/Fodder unit)	Value (€/ha of forest exploited)	Value (€/ha for entire site)	Value (€/ha of forest) 2001*
Morocco	296	0.46	138.2	142.4	28.3
Tunisia	457	0.16	72.9	72.9	73.9
Lebanon	116	0.3	76.7	76.7	6.4

* Merlo and Croitoru, 2005

Non-Timber Forest Products (NTFP)

The market price method was used by all the countries. Table 5 shows that some NTFP contribute significantly to the local economy as direct income or as employment-based income. The low value of cork in Morocco compared to the value obtained in Tunisia can be explained by the fact that mean production was taken into account over the entire production cycle. NTFPs (cork, cork oak acorns, truffles, etc.) also contribute substantially to the economic value of the cork oak forest in Morocco and in Tunisia. The differences from national values are due to the specific features of the sites and the differences in valuation methods.

Table 5: Values of some non-timber forest products on the sites studied (2014)

		Values obtained from the pilot sites				National value
	Product	Production (kg/ha)	Price (€/kg)	Value (€/ha of forest exploited)	Value (€/ha for entire site)	Value (€/ha of forest) 2001*
Morocco	Cork	10	0.20	28.1	1.1	1.2
Morocco	Cork oak acorns	360	0.37	133.3	74.5	
Tunisia	Cork	177	0.46	177.5	81.7	9.6
Algeria	Arbutus berries	22	3.1	68.4	0.7	
Lebanon	Thyme	12	3.8	44.1	44.1	124.3

* Merlo and Croitoru, 2005

[6] See the critical analysis of methods and data used – page 8

Recreation

Forest recreation is being increasingly developed given the large numbers of visitors to the pilot sites (see Table 6), which are located near major cities (Algiers, Rabat, Beirut). Table 6 shows a significant variation in recreation values, depending on the site. Although using an approach based on hectare of forest is not the best, the values obtained show that the value of this service can be very high compared to other goods and services. This service can also be developed in very small areas (23 ha in Turkey). It is clear that values obtained for individual recreation sites are higher than national values for all forests (see Table 6). Recreation is becoming an increasingly lucrative service due to the payment of entry fees (Lebanon, Turkey). When ecotourism is poorly organised, the benefits from recreation are threatened by overcrowding and the damage that is caused (case of Algeria). In addition, this activity generates significant revenue for the local population when catering services are made available and local products sold.

Table 6: Value of recreation in the sites studied (2014)

	Values obtained from the pilot sites				National value
	Number of visitors	Value (€/visitor)	Value (€/ha of recreational forest)	Value (€/ha for entire site)	Value (€/ha of forest) 2001*
Morocco	610,000	18.7	161.6	90.4	-
Algeria	85,000	2.6	172.0	11.4	-
Lebanon	5,919	7.1	33.7	7.6	4
Tunisia	206,110	1.6	14215.8	18.7	0.1

* Merlo and Croitoru, 2005

Hydrological services

Hydrological services such as water purification and protection of reservoirs from sedimentation provided by the forest are often considered as extremely important benefits in Southern Mediterranean countries. These benefits are characterised by water scarcity and the sensitivity of soil to erosion and landslides. This is the case for the two sites studied (Algeria, Tunisia) (see Table 7). National values are mean estimates of the values of services related to the protection of catchment areas and cannot therefore be directly comparable.

Table 7: Value of hydrological services in the sites studied (2014)

		Values obtained from the pilot sites			National value
	Service	Quantity/ha	Unit value	Value (€/ha for entire site)	Value (€/ha of forest) 2001*
Algeria	Water purification	251 m^3/ha	0.29 €/m^3	73.6	25
Tunisia	Reduction of sedimentation in dams	5.5 t /ha	3.64 €/t	19.8	26.3

* Merlo and Croitoru, 2005

Carbon

Using data on the increase in biomass and the value of carbon, the value of carbon obtained is quite high in Turkey, i.e. 58€/ha. This value is much higher than that obtained nationally in 2001 (7.7 €/ha) based on a unit value of carbon of €20/t (Merlo and Croitoru, 2005) and in 2015 (€7.9/ha), based on a unit value of €15/t CO_2 (Masiero *et al.* 2016). The difference is explained by the specific features of the site, the difference in the unit value of carbon and improved knowledge when it comes to assessing the quantity of sequestered carbon.

Conservation of biodiversity

By using the management costs for the fallow deer (*Dama dama*) breeding programme, in Turkey, the estimated value of biodiversity conservation is €4.5/ha. This value gives a rough idea of the cost of preserving biodiversity and therefore only represents a minimum value of the benefit associated with the conservation of biodiversity. Nationally, the mean value was €0.1/ha of forest in 2001, using the same method (Merlo and Croitoru, 2005). In some Mediterranean countries where the contingent valuation method was applied, the value (willingness to pay) associated with the conservation of biodiversity was estimated at €59.7/ha of forest in Croatia and €24.1/ha of forest in France in 2001 (Merlo and Croitoru, 2005).

DEGREE OF IMPORTANCE OF GOODS AND SERVICES IN THE SITES STUDIED

Using the value per hectare as an indicator, non-timber forest products and regulation services are the main benefits of the sites studied, ranked based on their economic value (see Table 8). The Merlo and Croitoru study (2005) also showed that non-timber forest products have a much higher value than wood. Recreation has the second highest value, explained by the increase in ecotourism demand. Wood resources, which are often the basis for analysis in forest development planning, are only ranked third. The results cannot be compared with national mean figures due to the specific features of the ecosystems chosen and their functions. The scale of the benefits for a given site chiefly depends on the characteristics of the site and social demand.

The values per hectare must be regarded as an order of magnitude estimate. Some values are underestimated/overestimated due to a lack of data and the working assumptions used. In addition to the values per hectare, values per resident can better express the benefits of the population residing in the area. These depend on the surface area of the forests and population numbers.

Table 8: Ranking of goods and services based on their economic value in the sites studied

Rank	Morocco	Algeria	Tunisia	Lebanon	Turkey
First	Fodder	Water purification	Fodder	Fodder	Carbon sequestration
Second	Recreation	Recreation	Cork	Thyme	Recreation
Third	Wood	Arbutus berries	Protection of the catchment area	Wood	Wood

Cost-effectiveness of management options

For each site, one or more management options have been identified based on the limitations and expected changes in terms of the supply of goods and services in order to reduce damage-related costs and/or increase the production of goods and services. The options are sometimes adapted by forest managers to compensate for the short-term loss of income suffered by local populations with income-generating activities (Lebanon). In some countries, the options put in place correspond to different management choices. Valuation is therefore used to identify the most economically attractive option.

Table 9: Identified management options by country

Morocco	**(M1) Maamora Forest twenty-year management and development plan (2016-2035)**
Algeria	(A1) Management of visitors using nature guides (A2) Use of a new recreation area (A3) Farm-out agreement – exclusive right to harvest arbustus berries in return for monitoring the massif during the summer
Tunisia	(T1) Acacia plantations along the banks of ravines (T2) Artificial regeneration of cork oak
Lebanon	(L1) Development of recreation and regulated exploitation of NTFP, together with income-generating activities.
Turkey	(T1) Development of a new recreation area (T2) Climate change to the ecosystem

ANALYSIS METHOD AND IMPLEMENTATION

The cost-benefit analysis (CBA) method shows whether or not an operation is cost-effective and determines the most cost-effective operation. It assesses the impact of an operation (or a combination of operations) in financial terms via the Net Present Value (NPV). The NPV corresponds to the difference between the net benefits associated with the operation and those which correspond to the scenario without action (European Commission, 2006). The option is considered of economic interest if the NPV of the option is positive, i.e. the current benefits are greater than the current costs. The benefits taken into account include the improvement of services provided by forest ecosystems. In addition, since costs and benefits occur at different times, a discount rate is used to express future values in relation to their current values. This rate often corresponds to the opportunity cost of capital[7].

Implementing this method for the pilot sites raises some data-related limitations, including the problem of properly anticipating the dynamics of physical and biological phenomena, and the production of products and services in the future.

In Morocco, it is assumed that there will be an increase in the production of goods and services (acorns, recreation, fodder, cork, etc.) from the first year following regeneration and plantation operations despite the fact that access will be prohibited (to ensure plantation survival) and that the plant population will still be young and not have reached the production stage. New plantations actually generate short-term losses, particularly in terms of pasturing benefits. The value of recreation is also difficult to predict. For Morocco, this value is assumed to be proportional to the reforestation area.

For Turkey, the value of recreation is assumed to rise progressively over 5 years to double the current recreational value. The analysis of the Climate Change Scenario in Turkey (scenario T2) is simply based on an assumption of a decrease in annual wood growth and therefore a 1% decrease in carbon sequestration.

The same applies for costs. Several assumptions have been made concerning the initial investment cost in Algeria, Lebanon and Turkey. In Algeria, it is assumed that forest fire surveillance costs will be cut in half and that the value of honey will increase significantly for the local population following implementation of management option A3.

In addition, the analysis period must cover the investment period. For forest species, it is best to analyse the costs and benefits throughout the entire production cycle. Furthermore, costs and benefits must be distributed by stakeholder to show

[7] For more information on the cost-benefit analysis method, please refer to Appendix 2 of this document.

the "winners" and "losers" following forest management changes. This is especially necessary in Morocco and Algeria to show to what extent compensation for defending new plantations could limit losses for the local population, and in Lebanon to demonstrate whether reducing damage, together with compensation would be beneficial to the various stakeholders.

RESULTS

The economic valuation identified management options that are of economic interest for society (positive NPV) when all the goods and services provided by the ecosystems are incorporated (see Table 10). These management options do not correspond to traditional development choices (such as wood production), but are aimed at improving recreational and environmental services. The economic analysis integrates commodities and the values corresponding to these services. Some options have a negative NPV when using relatively high discount rates (10%) but become positive when lower rates are used. The NPV for the cork oak plantation in Tunisia becomes positive when a rate of 2%[8] is used. The analysis also showed the extent of damage caused by the effects of climate change in Turkey and therefore the interest of looking at adaptation options. Also, when forest managers took into account the expectations of the local population, it resulted in significant gains for the various stakeholders.

Table 10: Net present value of management options adopted for the sites studied

	Scenarios	NPV			Stakeholders generating gains
		Period (years)	Rate	Value	
Morocco	**M1**	10	10%	+€2337/ha [9]	All beneficiaries
Algeria	**A1**	10	8.5%	+ €16/ha	A1: State (€11/ha), visitors (€1/ha), nature guide (€4/ha)
	A2			-€164/ha	A3: State (€32/ha), local pickers (€119/ha)
	A3			+ €151/ha	
Tunisia	**T1**	20	10%	+€138/ha	T1: National company (€116/ha), global community (€22/ha)
	T2			-€2510/ha	
Lebanon	**L1**	10	7.3%	+€37/ha	Association, visitors, local population
Turkey	**T1**	29	5%	+€260/ha	T1: State (€7/ha), visitors (€233/ha), Private sector (€19/ha)
	T2			-€114/ha	T2 : State (-€24/ha), (-€90/ha)

[8] The discount rate is a determining factor in estimating the net present value. Low rates are often used for environmental projects that run over a relatively long period. This is the case for cork oak with a production cycle of around 140 years. *The economics of ecosystems and Biodiversity (TEEB)* recommends using low discount rates (1 to 4%) for projects affecting the natural capital as there is no guarantee of the resource being available in the future (TEEB, 2010).

[9] The calculation was made assuming that there will be an increase in production for all goods and services provided by forests (acorns, recreation, fodder, etc.) following the development and extension of reforested areas, hence the high value compared to the other pilot sites.

Conclusions

The economic valuations carried out show the utility of these types of results as a decision-making mechanism for choosing management options and raising the awareness of decision-makers when it comes to using economic valuation as a tool for substantiating and directing forest ecosystem conservation and development. The studies conducted showed, for example, that the development of recreational activities and production of NTFP is beneficial for improving the contribution of forest ecosystems to the well-being of local and national populations and reducing damage to ecosystems. The increase in various values of ecosystem services provided to improve the well-being of the local and national population and the international community justifies investments in conservation, exploitation and development of forest ecosystems. It is also a tool to support the development of compensation systems and payments for ecosystem services (PES) mechanisms. In Tunisia, the analysis of the benefits of the acacia plantation indicates that it is possible to establish a PES mechanism where users of downstream water pay upstream farmers (Daly and Croitoru, 2010).

Assessments of goods and services also serve as a basis for negotiating and reaching compromises between stakeholders. On a regional scale, the link between the economic valuations of goods and services and the participatory governance initiatives put in place for this project transpires through the identification of win-win situations (such as in the case of Turkey, which benefits the State, the municipality, private enterprise, and visitors), by implementing compromises to resolve conflicts, or even co-management agreements (development of income-generating activities for local populations in order to reduce grazing in Lebanon, plantations of pastoral species to reduce overgrazing in Tunisia,, implementation of win-win co-management contracts between manager and local populations in Morocco[10]).Weaknesses are mainly tied to the methods used and the availability of data. The lack of biophysical (production of firewood and non-timber forest products) and economic (price) data is a major weakness that makes it impossible to accurately assess the value of goods and services. Valuation of some services (recreation, protection of biodiversity) requires surveys and modelling over short periods, which also causes problems. Finally, the specific features of sites (different ecosystems, relatively broad use of resources by the local population) makes it difficult to compare the results.

Overall, exploring the economic valuation of diverse cases and training national experts who are able to develop this type of assessment and disseminate results are assets for integrating economic valuation into forest resource management.

[10] See the " practical guide for the implementation of participative management and win-win co-management contracts for sustainable management of woodland areas" drafted by Mohamed Qarro in the framework of this project's component 3.

Lessons learned from implementing the methodologies and results

The approaches applied are appropriate in the Mediterranean context. However, data on the various goods and services should be developed by multidisciplinary research teams, with people who are specialised in quantifying forest production, sedimentation, water purification services, carbon sequestration and economic valuation. Biodiversity and land conservation were not assessed in depth due to a lack of data. In addition, the beneficial impact of grazing in reducing forest fires and cutting fire prevention and firefighting costs was not assessed. However, the resulting economic valuation of goods and services and the cost-benefit analysis can be considered important tools for choosing management options for the sites in question and identifying economic instruments to be used. The cost-benefit analysis must be conducted beforehand in order to assess the available management options and not to justify investments after the fact.

The difficulty and lack of accurate data often lead to assumptions that need to be underlined in the economic valuations. The risks and uncertainties also need to be taken into account as much as possible by presenting value ranges if necessary. Overestimating benefits should be avoided as results and even economic valuation as a decision-making tool can lose their credibility.

In view of these studies, the following actions can be considered in order for economic valuation tools to be used better:

- Improve knowledge and build capacities

There is a need to support economic valuation studies, teach economic valuation tools at the university level and organise training for forest resource development administrations and project managers (capacity building). The cost of forest degradation (i.e. overgrazing resulting in reduced fodder production, absence of regeneration and soil erosion, impact of cork/acorn harvesting on cork oak regeneration, forest fires, etc.) needs to be estimated along with the benefits of the ecosystems.

- Integrate economic valuation as a tool in the forest management process

This tool is used to compare the different management options proposed (as opposed to no action) in terms of costs and benefits, and to identify the most socially advantageous option. This is done by: (i) estimating the net private and social benefits without action (ii) assessing the private costs for each operation (iii) estimating the net private and social benefits with action (iv) comparing the net benefits of the operation as opposed to those with no action. This assessment helps target the operations with the greatest social impact and determine the economic consequences (i.e. gains and losses) for all stakeholders.

- Develop economic instruments to improve forest management / reduce degradation

This involves identifying and developing economic instruments and funding mechanisms leading to a compromise between local users and the off-site beneficiaries of ecosystem services via national assessments.

Given the fact that some stakeholders (farmers, users) could suffer a short-term loss of earnings following the implementation of sustainable management actions for forests, better economic and governance instruments need to be developed to improve management once the best operations have been identified and their financial aspects defined.

Traditional incentive systems and market-based economic tools (such as compensation mechanisms and Payments for Ecosystem Services) should be considered. Contractual measures (contracts, co-management agreements, collective management) between the manager and users and/or beneficiaries of the service should also be explored to ensure the sustainability of the service.

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Appendix

APPENDIX 1: GLOSSARY

Benefit function	The benefit function statistically relates peoples' willingness to pay to characteristics of the ecosystem and the people whose values were elicited.
Benefit transfer method	Estimates economic values by transferring existing benefit estimates from studies already completed for another location or issue.
Benefit-cost ratio	The relation between the discounted benefits and the discounted costs.
Benefits (CBA)	The increases in the quantity or quality of goods or services that generate positive utility or a reduction in the price at which they are supplied.
Choice experiment	A variety of choice modelling, where respondents are asked to select their most preferred alternative.
Consumers surplus	The difference between the price actually paid for a good, and the maximum amount that an individual is willing to pay for it.
Contingent Valuation	Survey based method to estimate the economic values of ecosystem goods and services by directly asking individuals about their willingness-to pay for or willingness to accept a change in the provision of these goods and services.
Cost-Benefit Analysis	A decision support method which aims to compare all relevant benefits and costs (in monetary terms) of an alternative (project, policy or programme), including impacts on environmental goods and services.
Cost-Effectiveness Analysis	A decision support method which relates the costs of alternative ways of producing the same or similar outcomes to a measure of those resulting outcomes.
Costs (CBA)	Any decreases in the quality or quantity of such goods or services, or increases in their price.
Costs based methods	Estimate values of ecosystem goods and services based on either the costs of avoiding damages due to lost goods and services, the cost of replacing ecosystem goods and services, or the cost of providing substitute goods and services.
Damage cost avoided method	The damage cost avoided method is applied using two different approaches: (i) to use the monetary value of the probable damages if nothing is done; or (ii) to determine the avoidance expenditures against a damage in order to provide an estimate of the benefits from the change in the ecosystem (family of the cost based methods).
Direct use value	Is derived from interaction with the ecosystem through consumptive or non-consumptive use.
Discount rate	The rate used to reduce future benefits and costs to their present time equivalent.
Economic evaluation	The process of determining the economic performance of an alternative in regard to the objectives, and results of any such action that has been completed.
Economic valuation	The process of estimating the economic value of a good or service.
Ecosystem function	Refers to the capacity of natural ecological processes, structures and components to provide goods and services that can potentially satisfy human needs, either directly or indirectly.
Ecosystem Goods	Tangible outputs from ecosystems that benefit directly or indirectly to humans, and contribute to their well-being.
Ecosystem Services	Intangible outputs from ecosystems that benefit directly or indirectly to humans, and contribute to their well-being.
Hedonic pricing	Estimates economic values for ecosystem or environmental services that directly affect market prices of some other good.
Indirect use value	Is derived from ecosystem services, such as cleaner water to downstream users, carbon sequestration, flood control or erosion prevention.
Internal rate of return	The critical value of the interest rate at which the project has a net present value of zero.

Investment projects	Long-term allocation of funds (with or without recourse to the project's sponsor) to carry an investment idea through to its stable-income generation stage.
Market price method	Estimates economic values for ecosystem goods or services based on market prices.
Multi-Criteria Analyisis	Is a decision support method that can be used to evaluate different alternatives and compare alternatives according to their performance with regard to a selected set of evaluation criteria.
Net present value	The current value of net benefits (benefits minus costs) that occur over time.
Non-Use Values	Values which are not associated with actual use, or even the option to use a good or service.
Opportunity cost	Measures the best alternative option forgone in a situation in which a choice needs to be made between several mutually exclusive alternatives given limited resources
Present value	The current value of benefits or costs.
Producer surplus	The difference between the total amount earned from a good (market price times quantity sold) and the variable production costs.
Replacement cost method	Is applied by estimating the costs of replacing the affected ecosystem goods and services (family of the cost based methods).
Revealed preferences	Estimate the values of ecosystem goods and services are based on actual observed behaviour data, including some techniques that deduce values indirectly from behaviour in surrogate markets, which are assumed to have a direct relationship with the ecosystem service of interest.
Sensitivity analysis	A technique used to determine how different values of an independent variable will impact a particular dependent variable under a given set of assumptions.
Social CBA	Considers the costs and benefits which accrue to the society as a whole
Social costs of carbon (SCC)	SCC is a monetary indicator measuring the present value of the global damage caused by an additional ton of green-house gasses emitted into the atmosphere.
Social discount rate	Measures the society's preferences between consumption in one period and consumption in another
Stated preferences	Survey based methods to estimate the economic values of ecosystem goods and services by directly or indirectly asking individuals about their willingness-to pay for or willingness to accept a change in the provision of these goods and services.
Substitute cost method	Is applied by estimating the costs of providing a substitute for the affected goods and services (family of the cost based methods).
Total economic value	The sum of all types of use and non-use values for a good or service.
Travel cost method	Estimates economic values of ecosystem goods or services based on how much people are willing to pay to travel to visit the site.
Value	Is a direct or indirect quantification/measurement (economic, sentimental, etc.) of the benefit obtained from a given service.
Willingness to accept	The amount—measured in goods, services, or monetary units—that a person is willing to accept in exchange for giving up a particular good or service.
Willingness to pay	The amount—measured in goods, services, or monetary units—that a person is willing to give up to get a particular good or service.

APPENDIX 2: ECONOMIC VALUATION METHODS DESCRIPTION[11]

Comparison of economic valuation methods

There are two main groups of economic valuation methods: revealed preferences methods (RP) and stated preference methods (SP).

Revealed preference methods are based on actual market behaviour of users of ecosystem goods and services. However, their applicability is limited only to a few ecosystem goods and services.

Stated preference methods can be applied to all types of ecosystem goods and services. However, their main disadvantages are that they are based on hypothetical situations and their application is complex and resource consuming.

Method group	Valuation method	Forest good or service valued	Value captured	Affected population captured	Benefits of method	Limitations of method
Revealed preference methods	**Market price**	Those that are traded in markets, mainly resources (e.g., timber, fuel-wood, cork, non-wood forest products)	Direct and indirect use	Users	Market data available and robust	Limited to market goods and services
	Cost-based *	Mainly ecological services: soil protection, water protection, climate regulation	Direct and indirect use	Users	Market data available and robust	Can potentially overestimate actual value
	Hedonic pricing	Services that contribute to the quality of attributes of a certain market good, e.g., air quality, landscape aesthetics, noise reduction	Direct and indirect use	Users	Based on market data	Very data intensive and limited mainly to data related to property
	Travel cost	All ecosystem services that contribute to recreational activities	Direct and indirect use	Users	Based on observed behaviour	Limited to recreation and problematic for multiple destination trips
Stated preference method	**Contingent valuation**	All goods and services	Use and non-use	Users and non-users	Able to capture all use and non-use values	Potential bias in response, hypothetical market (not observed behaviour), resource-intensive
	Choice experiment	All goods and services	Use and non-use	Users and non-users	Able to capture all use and non-use values	Potential bias in response, hypothetical market (not observed behaviour), resource-intensive

* Cost based methods category considers all three approaches (damage costs avoided, replacement costs and substitution costs) which are equally applicable.

The benefit transfer method is an alternative to RP and SP methods, as it typically requires less resources and time. However, it is not a valuation method, as it only uses values estimated in other valuation studies, which are performed for similar goods or services, and then transfers this values to estimate the value of goods or services on another site by using correction factors or meta-data analysis. However, the method is still relatively new and no widely accepted standards for its application have been adopted yet.

Employing one or the other method will depend on the objectives of the study and of the degree of familiarity with the different methods. The final selection of the method depends on many factors, like: (i) type and number of objects to be valued; (ii) relevant population (e.g. users or non-users or both; geographical scope (local, regional, national, international);

[11] The following technical sheets are from Plan Bleu, 2014. Methods and socioeconomic assessment tools for goods and services provided by Mediterranean forest ecosystems. Technical Report prepared by the CTFC and EFIMED, French GEF Project. This document is downloadable on Plan Bleu website: www.planbleu.org

(iii) data availability (e.g. restricted data access – data on house values); (iv) available time and financial resources; (v) team (e.g. experience).

Table 11: Overview of the use valuation methods in relation to valued goods and services

Group	Forest Good/Service	Valuation method*					
		MP	CB**	HP	TC	CV	CE
Resources	Industrial wood	+	o	-	-	-	-
	Fuelwood	+	o	-	-	-	-
	Cork	+	o	-	-	-	-
	Food products	+	o	-	-	-	-
	Fodder and forage	+	+	-	-	-	-
	Decorative material	+	o	-	-	-	-
	Hunting and game products	+	o	-	-	-	-
	Pharmaceuticals, Cosmetics and other raw materials for industrial application	+	o	-	-	-	-
Biospheric	Biodiversity protection	-	o	-	-	+	+
	Climate regulation	-	+	-	-	+	+
	Air quality regulation	-	+	+	-	+	+
	Carbon sequestration	o	+	-	-	+	+
Ecological	Health protection	-	+	-	-	+	+
	Water regulation	-	+	-	-	+	+
	Water purification	o	+	-	-	+	+
	Soil protection	o	+	-	-	+	+
Social	Recreation	o	o	-	+	+	+
	Tourism	o	o	-	o	+	+
Amenities	Spiritual and cultural services	-	-	-	-	+	+
	Historical and educational services	-	-	-	-	+	+
	Aesthetic services	-	o	+	o	+	+

*MP – market price based method; CB – cost based methods; HP – hedonic pricing method; TC – travel cost method; CV – contingent valuation method; CE – choice experiment method

** Cost based method category considers all three approaches (damage costs avoided, replacement costs and substitution costs), which are equally applicable.

+- typically used; o – sometimes used; - not applicable

Revealed preferences

Market price method

General description:

The market price method estimates the economic value of ecosystem goods or services that are bought and sold in markets. The market price method can be used to value changes in either the quantity or quality of a good or service. It uses standard economic techniques for measuring the economic benefits from marketed goods and services, based on the quantity people purchase at different prices, and the quantity supplied at different prices. Market price represents the value of an additional unit of that good or service, assuming the good or service is sold through a perfectly competitive market (that is, a market where there is full information, identical products being sold and no taxes or subsidies).

Goods and services valued:

The market price method uses prevailing prices for goods and services traded in markets, such as timber, fuelwood, non-wood forest products (e.g., mushrooms, berries, aromatic and medicinal plants, etc.).

Main steps of application:

1. Estimate of demand function before the change in provision - use market data to estimate the market demand function and consumer surplus for the valued good or service before the change in the provision.
2. Estimate of demand function after the change in provision - estimate the market demand function and consumer surplus for the good or service after the change in provision has occurred.
3. Estimate of the change in economic benefits to consumers - calculating the difference in benefits before and after the change in provision.
4. Estimate of supply function before the change in economic benefits to producers
5. Estimate of supply function after the change in economic benefits to producers
6. Estimate of the change in economic benefits to producers - calculate the difference in producer surplus due to the change in the provision of the valued good or service
7. Estimate of the total economic change - sum of changed consumer surplus and changed producer surplus.

Strengths:

- People's values are likely to be well-defined as it reflects an individual willingness to pay for costs and benefits of goods or services that are bought and sold in markets.
- Data are relatively easy to obtain.
- Uses observed data of actual consumer preferences.
- Uses standard, accepted economic techniques.

Weaknesses:

- Market data only are available for a limited number of goods and services.
- True economic value of goods or services may not be fully reflected in market transactions.
- Seasonal variations and other effects on price must be considered.
- Cannot be easily used to measure the value of larger scale changes that are likely to affect the supply of or demand for a good or service.
- Usually, the market price method does not deduct the market value of other resources used to bring ecosystem products to market, and thus may overstate benefits.

Application example:

Daly et al. (2012) estimated the value of annual wood production for the forests in the Barbra watershed basin. Forest covers around 31% of the total area of this watershed basin. One of the benefits these forests provide is wood. It was estimated that in 2010 the annual wood increment for the total area was 4,516 m^3. However, a survey conducted in the area showed that households consume on average 1.48 m^3 of fire wood and 155 kg of charcoal per year. Multiplying these amounts by the number of households in the area this means that the total consumption was 10,351 m^3 of wood (6,650 m^3 of fire wood and 3,701 m^3 wood for charcoal production), which is much higher than the estimated annual production capacity of the forests in the Barbra watershed basin. This clearly indicates the importance of the consideration of self-consumption of forest products by the population.

To estimate the annual benefit of wood production for the local population the market price for fire wood was used, which was in 2010 around 4.35 €/m^3. Thus, estimated the total annual benefit was 45,026 €.

Source : Daly, H., Croitoru, L., Tounsi, K., Ali, A., Sihem, J., 2012. Evaluation économique des biens et services des forêts tunisiennes - Rapport final, Société des Sciences Naturelles de Tunisie (SSNT).

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 43-46.

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http://www.oecd-ilibrary.org/environment/valuation-of-biodiversity-benefits_9789264195844-en

Cost based methods

General description:

The cost based methods (damage cost avoided, replacement cost, and substitute cost methods) are related methods that estimate values of ecosystem goods and services based on either the costs of avoiding damages due to lost services, the cost of replacing environmental assets, or the cost of providing substitute goods or services. The **damage cost avoided** method uses either the value of property protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an ecosystem. The **replacement cost method** uses the cost of replacing an ecosystem or its goods and services as an estimate of the value of the ecosystem or its goods and services. Similarly, the **substitute cost method** uses the cost of providing substitutes for an ecosystem or its goods and services as an estimate of the value of the ecosystem or its goods and services.

Goods and services valued:

These methods might be applied for valuing improved water quality, erosion protection services, water purification services, storm protection services, and habitat and nursery services.

Main steps of application:

1. Ecological assessment of the provided good or service - determine the current level of the ecosystem good or service, and the expected level if any change in the ecosystem would occur.
2. Cost assessment - The *damage cost avoided* method estimates potential damages or expenditures on damage avoidance or protection. The *replacement cost method* estimates costs of replacing the affected ecosystem goods or services. The *substitute cost method* is applied by estimating the costs of providing a substitute for the affected goods or services.

Strengths:

- Rough indicator of economic value, subject to data constraints and the degree of similarity or substitutability between related goods or services.
- Easier to measure the costs of producing benefits than the benefits themselves, when goods, services, and benefits are non-marketed.
- Less data- and resource-intensive.
- Provide surrogate measures of value that are as consistent with the economic concept of use value, for goods or services which may be difficult to value by other means.

Weaknesses:

- Expenditures to repair damages or to replace ecosystem goods and services are not always measures of the benefits provided.
- Do not consider social preferences for ecosystem goods and services.
- In certain cases, the cost of a protective action may actually exceed the benefits to society.
- Substitute goods or services are unlikely to provide the same types of benefits as the natural resource.
- Goods or services being replaced probably represent only a portion of the full range of goods and services provided by the natural resource.

Application example:

In the Tazekka national park a study was conducted to estimate of the total economic value of the goods and services provided by the park. The Tazekka national park is located in the Middle Atlas, near the city of Taza, in Morocco. The park provides a wide range of ecosystem goods and services, in particular to the local population, as it significantly contributes to the local economic development, (e.g., income from tourism, agricultural and forest products).

The ecosystem goods and services provided by the park were grouped into: economic (agricultural production, forest products, fodder, water provision), ecological (soil conservation, water reserves and quality, carbon sequestration, biodiversity conservation), and social (recreation, tourism, cultural, education, and spiritual).

The forest fodder production value was estimated by using the substitute cost method. In the valuation approach the quantities of the forest fodder and costs of substituting it by barley were estimated.

Using this approach, it was estimated that 11,006 ha of forests provide approximately 4 million fodder units. Considering a barely price of 0.31 €/kg, the total economic value obtained for the fodder production was 1.26 million euros. Further, the authors also considered the degradation caused by overgrazing. Thus, they reduced the total benefit of fodder provision by the cost of overgrazing. Finally, the benefit of fodder production was estimated at 902,775 € or approximately 82 €/ha.

Source: Jorio, A., Evaluation économique de la biodiversité et des services écosystèmiques du parc national de Tazekka et impact des changements climatiques sur ces services, Haut Commissariat aux Eaux et Forêts et à la Lutte contre la Désertification, Royaume du Maroc, July 2011.

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 46-48.

Further reading:

Pearce, D. (2001) Valuing biological diversity: issues and overview. In: OECD: Valuation of Biodiversity Benefits. Selected studies. Paris, OECD, pp. 27-44.

http://www.oecd-ilibrary.org/environment/valuation-of-biodiversity-benefits_9789264195844-en

Hedonic pricing method

General description:

The hedonic pricing method (HP) relies on market transactions for differentiated goods to estimate the economic benefits or costs associated with environmental quality. The basic premise of the HP method is that the price of a marketed good is related to its characteristics, or the services it provides.

For example, the price of a house is related to the characteristics of the house and property itself, the characteristics of the neighbourhood and community, and environmental characteristics. Thus, if non-environmental factors are controlled for, then any remaining differences in price can be attributed to differences in environmental quality. For example, if all characteristics of houses and neighbourhoods throughout an area were the same, except for the level of air pollution, then houses with better air quality would cost more. This higher price reflects the value of cleaner air to people who purchase houses in the area.

Goods and services valued:

The hedonic prizing method is mainly used to estimate economic values for economic benefits or costs associated with environmental quality (e.g., air pollution, water pollution, or noise) and environmental amenities (e.g., aesthetic views or proximity to recreational sites).

Main steps of application:

1. Collection of data on property value and attributes, and environmental quality attributes - to estimate a hedonic price function in order to calculate implicit prices, that is the marginal willingness to pay for the evaluated attributes of the property.
2. Sampling - the size of area and the period for which the data is collected have to be determined.
3. Model estimation and welfare estimates - the choice of the functional form is a crucial issue as it can substantially impact results.

Strengths:

- Can be used to estimate values based on actual choices.
- Property markets are relatively efficient in responding to information, so can be good indications of value.
- The method is versatile, and can be adapted to consider several possible interactions between market goods and environmental quality.
- Property records are typically very reliable.

Weaknesses:

- Scope of environmental benefits that can be measured is mainly limited to things that are related to housing prices.
- Only captures people willingness to pay for perceived differences in environmental attributes, and their direct consequences.
- Assumes that people have the opportunity to select the combination of features they prefer, given their income.
- Results depend heavily on model specification.
- Large amounts of data must be gathered and manipulated.
- Relatively complex to implement and interpret, requiring a high degree of statistical expertise.
- Time and expense to carry out an application depends on the availability and accessibility of data.

Application example:

Tyrväinen (1997) studied whether and how urban forests benefits are capitalized in property prices in Joensuu (Finland). As the dependent variable the author used real estate prices (Finish Marks/m^2) from 14 different housing areas (a total of 1006 observations) and as independent variables different housing characteristics, like size, age, location, proximity of schools and other urban services, proximity of wooded area and watercourses.

The author applied a linear and semi-log regression models to estimate the impact on housing, location and environmental characteristics on the housing price. The obtained results indicate that the proximity to different environmental amenities positively affects housing prices. For example, a 100 m increase in distance

to a watercourse decreased the housing price by 25.9 €/m^2. In the same way, an 100 m increase of distance to forest recreation site decreases the housing price by 7.06€/m^2.

Source: Tyrväinen, L., "The amenity value of the urban forest: an application of the hedonic pricing method", Landscape and Urban Planning, 37, 1997, 21 -222

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 49-52.

Further reading:

Riera, P., Signorello, G., (Eds.) 2012. Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. University of Catania.

http://www.efi.int/files/attachments/e45/publications/1cost_e45_guidelines.pdf

Travel cost method

General description:

The travel cost method is used to estimate the value of recreational benefits generated by ecosystems. It assumes that the value of the site or its recreational services is reflected in how much people are willing to pay to get there. There are several varieties of the travel cost method: simple zonal travel cost method (using mostly secondary data), individual travel cost method (using a more detailed survey of visitors and statistical analysis), and random utility travel cost method (using survey and other data, and statistical techniques).

The basic premise of the travel cost method is that the time and travel cost expenses that people incur to visit a site represent the value of access to the site. Thus, peoples' willingness to pay to visit the site can be estimated based on the number of trips that they make at different travel costs. This is analogous to estimating peoples' willingness to pay for a marketed good based on the quantity demanded at different prices.

Goods and services valued:

The travel cost method is used to estimate use values associated with the recreational services that ecosystems or sites provide. The method can be used to estimate the economic benefits or costs resulting from (i) changes in access costs for a recreational site, (ii) elimination of an existing recreational site, (iii) addition of a new recreational site or (iv) changes in environmental quality at a recreational site.

Main steps of application:

1. Definition of the site – defining the boundaries and attributes of the valued site.
2. Definition of the target population – the population of interest mainly includes current and potential visitors of the valued site.
3. Definition of the sampling strategy – manly deciding between on-site and off-site sampling or a combination.
4. Survey implementation – the type of questions will depend on the aim of the study and needed data.
5. Calculation of travel costs and other costs – specifying which type of costs will be considered to calculate travel cost.
6. Model estimation and welfare estimates - depends on study objective and data: single-site travel cost regression models or random utility travel cost regression models.

Strengths:

- Similar to more conventional approaches to estimate economic values based on market prices.
- Based on actual behaviour, and therefore more reliable that methods based on hypothetical behaviour of the respondents.
- On-site surveys provide opportunities for large sample sizes.
- Results are relatively easy to interpret and explain.
- Relatively inexpensive to apply.

Weaknesses:

- Assumption that people respond to changes in travel costs the same way that they would respond to changes in admission price might not always be true.
- Limited in its scope of application because it requires user participation.
- Standard approaches provide information about current conditions, but not about gains or losses from anticipated changes in resource conditions.
- The most simple travel cost models assume that individuals take a trip for a single purpose.
- The availability of substitute sites will affect values.
- The method can underestimate the value for people living next to the valued site.
- Measuring the opportunity cost of time can be problematic.
- It cannot be used to measure non-use values.

Application example:

Among the environmental goods and services provided by Mediterranean forests, wild mushroom picking is

particularly appreciated. Where access to the forests is free, and when the property rights to the products are not clearly assigned, forest owners receive no benefits. Therefore, they have little incentive to provide forests with improved mushroom production, regardless of how socially desirable this would be. If the value of this environmental service to society was known, an appropriate policy could be applied to correct this situation.

To estimate the recreational benefit of mushroom picking in Solsonès county (Catalonia, Spain) a travel cost method was applied. A questionnaire was drawn up to survey a sample of mushroom pickers in Solsonès. To calculate the number of mushroom pickers, the vehicles parked at forest entrances were counted on selected days. The quantities of mushrooms picked were estimated by appraising the success of the mushroom pickers surveyed. Finally, mushroom prices in the market were recorded. The study was conducted in September, October, November and December 2001, 2002 and 2003. A sample of 300 people was surveyed in the three years period. Mushroom pickers were randomly selected on exit from different forest locations.

The survey showed that mushroom pickers made an average of 4.56 trips to the forests of Solsonès County during the mycological autumn season. The econometric analysis showed that the average consumers surplus was 39.26€ per trip. Considering that for the Solsonès County about 18,000 mushroom picking visits were estimated per year the total net benefit was about 710,000€.

Source: Martínez de Aragón, J., et al., Value of wild mushroom picking as an environmental service, Forest Policy and Economics (2011), doi:10.1016/j.forpol.2011.05.003.

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 52-57.

Further reading:

Riera, P., Signorello, G., (Eds.) 2012. Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. University of Catania.

http://www.efi.int/files/attachments/e45/publications/1cost_e45_guidelines.pdf

Stated preferences

Contingent valuation method

General description:

The contingent valuation method is a questionnaire based technique that seeks to discover individual preferences for an environmental change. These are the only methods that can assess non-use values of ecosystems but can also be used to estimate use values generated by the ecosystems. In addition, due to their hypothetical nature, these methods can be used to assess social preferences ex-ante, i.e., for changes that have already not taken place.

The basic premise of the contingent valuation method is that individuals are sensitive to a given environmental change and that their preferences could be measured in terms of their willingness to pay to undergo (or their willingness to accept a compensation to avoid) this change. Therefore, the given change is presented to individuals through a survey where the environmental change is presented and where people are asked to state their willingness to pay or their willingness to accept the given environmental change.

Goods and services valued:

The contingent valuation method is used to estimate non-use values that ecosystems provide, but can simultaneously estimate use values such as recreational values associated with these ecosystems. The method can be used to estimate the economic benefits or costs resulting from an environmental change that has an impact on (i) non-use values, such as existence values people hold for biodiversity, (ii) use-values such as recreational values or landscape values people hold for a given natural site.

Main steps of application:

1. Definition of the valuation objective – defining the objective of the valuation study.
2. Selection of the survey type - defining the way the survey will be implemented (e.g., in person, mail, phone, web).
3. Questionnaire elaboration – preparation of a draft questionnaire, which includes the definition of the elicitation response format.
4. Definition of the target population – who will be surveyed.
5. Definition of the sampling – the sampling strategy is selected (e.g., random sampling or stratified sampling).
6. Test the questionnaire in focus groups and in pilot surveys – to test the consistency and respondents' perception.
7. Launch the survey and collect the data from your sample.
8. Statistical analysis – including the definition of the bid and the probability functions and the estimation model parameters.

Strengths:

- They are the only available methods to estimate non-use values.
- They can also be employed to estimate use values.
- The use of surveys allows to collect relevant socioeconomic and attitudinal data on the respondents that could be relevant for understanding the variables influencing social preferences and choices.
- The use of surveys allows to estimate hypothetical changes and their impact before they have taken place.
- Participative/deliberative approaches before valuing the good or service at stake seem to provide with more stable results.

Weaknesses:

- Preferences for non-use values tend to be less stable.
- Complex questionnaire development and data analysis.
- Budget and time demands are high.
- High risk of biases that may lead to inaccurate WTP estimations.
- If the surveyed population has a low level of literacy it would pose significant constraints for the implementation of a questionnaire where respondents have to read. In such cases, face-to-face interviews, use of local language and local enumerators are suggested.
- The traditional knowledge people have, particularly in rural areas, may not always align with the approached used by experts in questionnaires.

Application example:

To estimate the values French population hold for their forest ecosystems, a questionnaire was drawn up to survey a sample of a representative sample of 4,500 French households through telephone interviews.

The main goods and services valued were both use (e.g., resistance to catastrophes, food provision, medicines, raw materials, water supply, carbon storage, leisure, tourism) and non use values (existence, legacy). The households were asked if they had visited any forests during the time surveyed, and more generally about their different activities in the forests.

The valuation scenario was the hypothetic implementation of different protection and maintenance measures to conserve the biodiversity of forests. The survey used a referendum format and respondents were asked on the amount of money they would be willing to pay in order to finance conservation measures. The prices offered in the referendum ranged between 6 € and 90 €.

The values obtained vary according the revenues and regions. The main willingness to pay for the whole country fluctuated between 45€ and 64€ per household per year, while the results showed significant differences between the North (including Paris) with a mean of around 64€, the East (between 50 € and 55€) and the South-West of France (45€).

Source: Garcia et. al. Valuing forest biodiversity from a National Survey in France: A Dichotomous Choice Contingent Valuation. Document de travail du Laboratoire d'Economie Forestière (LEF), INRA, n°2007-08 (2007).

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 57-65.

Further reading:

Riera, P., Signorello, G., (Eds.) 2012. Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. University of Catania.

http://www.efi.int/files/attachments/e45/publications/1cost_e45_guidelines.pdf

Choice experiment method

General description:

The choice experiment method is a questionnaire based technique that seeks to discover individual preferences for simultaneous changes in the attributes that compose an environmental good or service. States preference methods are the only methods that can assess non-use values of ecosystems but can also be used to estimate use values generated by the ecosystems. In addition, due to their hypothetical nature, these methods can be used to assess social preferences ex-ante, i.e., for changes that have already not taken place.

The basic premise of the choice experiment is that a forest good or service can be decomposed in a bundle of attributes or features and that individuals are sensitive to changes in these attributes. Therefore, individuals are asked through a survey to state their willingness to pay to undergo these changes.

Goods and services valued:

The choice experiment method is used to estimate non-use values that ecosystems provide, but can simultaneously estimate use values such as recreational values associated with these ecosystems. The method can be used to estimate the economic benefits or costs resulting from an environmental change that has an impact on (i) non-use values, such as existence values people hold for biodiversity, (ii) use-values such as recreational values or landscape values people hold for a given natural site.

Main steps of application:

1. Define the valuation objective – defining the objective of the valuation study
2. Select the survey type - defining the way the survey will be implemented (e.g., in person, mail, phone, web)
3. Questionnaire elaboration – preparation of a draft questionnaire, which includes the definition of the attributes, their levels and structuring of the choice sets
4. Define the target population – who will be surveyed
5. Define the sampling – the sampling strategy is selected (e.g., random sampling or stratified sampling)
6. Test the questionnaire in focus groups and in pilot surveys – to teste the consistency and respondents' perception
7. Launch the survey and collect the data from your sample
8. Statistical analysis – calculating the attributes' coefficients and implicit prices

Strengths:

- They are the only available methods to estimate non-use values.
- They can also be employed to estimate use values.
- The use of surveys allows to collect relevant socioeconomic and attitudinal data on the respondents that could be relevant for understanding the variables influencing social preferences and choices.
- The use of surveys allows to estimate hypothetical changes and their impact before they have taken place.
- Participative/deliberative approaches before valuing the good or service at stake seem to provide with more stable results.

Weaknesses:

- Preferences for non-use values tend to be less stable
- Complex questionnaire development and data analysis.
- Budget and time demands are high
- High risk of biases that may lead to inaccurate WTP estimations.
- If the surveyed population has a low level of literacy it would pose significant constraints for the implementation of a questionnaire where respondents have to read. In such cases, face-to-face interviews, use of local language and local enumerators are suggested.
- The traditional knowledge people have, particularly in rural areas, may not always align with the approached used by experts in questionnaires.

Application example:

An application of the choice experiment was carried out to assess the preferences of the Moroccan society for different management options, aimed to improve or conserve different ecosystem goods and services provided by the forest of Bouhachem, in Northern Morocco. The main forest goods and services valued on

the study are food and forage production, soil protection, water cycle regulation, biodiversity conservation, recreation and tourism.

The assessed attributes were: conservation (reducing the loss of biodiversity and the perturbations in the cycle of water), soil protection (presented as erosion), restrictions to wood and forage provision, recreational and touristic activities. These were combined to create alternative management scenarios that people had to value.

A questionnaire was distributed to a sample of 396 individuals representative of the Moroccan society (terms of age, residence and gender diversity). A latent class model with four classes was estimated. These models assume that the population is divided in a finite number of groups within which the preferences of the individuals are homogenous and different from these of other groups or classes.

The results show that the WTP of the Group 1 for the conservation, erosion and recreation attributes are not significant, which means that for this group changes in erosion and recreation attributes have no impact on the welfare. On the other hand, they would pay 0.40€ for restricting the use of the forest. The WTP of Group 2 for the conservation attribute is the value is 0.28€, which is the amount of money that the respondents would be willing to pay to conserve biodiversity. On the other hand, they would experience a loss of welfare of -0.61€ per each extra unit (ha) of eroded forest area, and of -0.38€ if the use of the forest is restricted. The WTP of Group 3 for the conservation attribute is 0.44€ (they would pay for conserving biodiversity). They would experience a loss of welfare of -0.61€ for each extra unit of eroded surface. Their WTP for the restriction of the use of the forest is 0.17€, and their WTP for the recreational attribute is 1.06€. The WTP of the Group 4 for the conservation, erosion and restriction attributes is not significant. They would experience a welfare increase of 2.47€ if the forest would be contributing to an increase of tourism.

Source: Mavsar, R., Farreras, V. (2010). Gestion durable du capital naturel de la forêt de Bouhachem (Chefchaouen, Maroc) : garantie des bénéfices sociaux, économiques et environnementaux. Centre Tecnològic Forestal de Catalunya.

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 57-65.

Further reading:

Riera, P., Signorello, G., (Eds.) 2012. Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. University of Catania.

http://www.efi.int/files/attachments/e45/publications/1cost_e45_guidelines.pdf

Benefit transfer

Benefit transfer method

General description:

Benefit transfer method is not a valuation method as such, but it is a method that involves transferring economic estimates from previous studies of similar changes in environmental quality to value the environmental change at the policy site. Thus, the basic goal of benefit transfer is to estimate benefits for one context by adapting an estimate of benefits from some other context.

Benefit transfer is often used when it is too expensive and/or there is too little time available to conduct an original valuation study, yet some measure of benefits is needed. It is important to note that benefit transfers can only be as accurate as the initial study.

There are two main forms of the benefit transfer method:

- Unit transfer method is the simplest method to transferring benefit estimates from a study site, or as a mean from several study sites, to the policy site.
- Function transfer method transfers a benefit function from another study. The benefit function statistically relates people willingness to pay to ecosystem characteristics and the people whose values were elicited.

Goods and services valued:

The benefit transfer method can be applied for all ecosystem goods and services. However, it was showed that it is more reliable for transferring use values (e.g., recreation).

Main steps of application:

1. Identify the change in the environmental goods and services to be valued at the policy site.
2. Identify the affected population at the policy site - including size and socioeconomic characteristics.
3. Conduct a literature search to identify relevant primary studies - preferably based on a database; but supplemented by journal and general web searches.
4. Assessing the relevance/similarity and quality of study site values for possible transfer.
5. Select and summarize the data available from the study site(s).
6. Transfer value estimate from study site(s) to policy site.
7. Calculate total benefits or costs.
8. Assess of the uncertainty and transfer error / Conduct a sensitivity analysis.

Strengths:

- Benefit transfer is typically less costly than conducting an original valuation study.
- Economic benefits can be estimated more quickly than when undertaking an original valuation study.
- The method can be used as a screening technique to determine if a more detailed, original valuation study should be conducted.
- The method can easily and quickly be applied for making gross estimates of recreational values. The more similar the sites and the recreational experiences, the fewer biases will result.

Weaknesses:

- Benefit transfer may not be accurate, except for making gross estimates of recreational values, unless the sites share all of the site, location, and user specific characteristics.
- Good studies for the policy or issue in question may not be available.
- It may be difficult to track down appropriate studies, since many are not published.
- Reporting of existing studies may be inadequate to make the needed adjustments.
- Adequacy of existing studies may be difficult to assess.
- Extrapolation beyond the range of characteristics of the initial study is not recommended.
- Benefit transfers can only be as accurate as the initial value estimate.
- Unit value estimates can quickly become dated.

Application example:

Zandersen and Tol (2009) conducted a function transfer method to study recreational values in Europe.

This study systematically analysed the variation in data from different sources, to identify the extent to which methods, design and data affect reported forest recreation values. Only studies conducted in Europe that have applied the travel cost method had been considered. A total of 26 studies from nine European countries published between 1977 and 2001 were used.

The data indicates that there is a substantial variance in forest recreation values across studies, ranging from 0.66 to 112€ per trip with a median of 4.52€. Despite the similarities in valuation methods applied (all studies were conducted with travel cost method) and environmental service valued, the summarised benefit estimates reflect methodological, geographical and temporary differences. Namely, the values are influenced by the measurement of value (e.g., value per trip, per day or per season), by the travel cost approach (i.e., zonal versus individual travel cost method), by the definition of costs (i.e., inclusion and level of opportunity cost of time, composition of car-borne travel costs) and other methodological issues (e.g., inclusion of substitute sites, postal or face to face interviews, or specification of functional form of the meta-analysis). Also, the inclusion of exogenous data on location and site characteristics reveals that site-specific characteristics such as size, age diversity, area of open land within a forest site have distinctive effects on benefits summarised in a meta-analysis.

Source: Zandersen,M., Tol, R., A meta-analysis of forest recreation values in Europe, Journal of Forest Economics, Volume 15, Issues 1–2, p. 109-130.

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 65-71.

Further reading:

Riera, P., Signorello, G., (Eds.) 2012. Good Practice Guidelines for the Non-Market Valuation of Forest Goods and Services. University of Catania.

http://www.efi.int/files/attachments/e45/publications/1cost_e45_guidelines.pdf

Cost-benefit analysis

Cost-benefit analysis method

General description:

Cost-benefit analysis (CBA) is a technique for the assessment of the relative desirability of competing alternatives (events, project, management or policy measures). The assessment involves the comparison of the current (*base case*) situation to one or more *alternatives* considering the differences between the base case and the alternatives. The analysis would focus on the differences in costs (negative impacts) and benefits (positive impacts), in the situations with and without the management measure. The CBA compares the costs and benefits measured in monetary terms.

Private CBA considers only those costs and benefits from the analysed alternative, which are imposed onto or accrue to a private agent (e.g. individual or firm). This approach is also often called financial appraisal. *Social CBA* in turn attempts to assess the overall impact of an alternative on the welfare of the society as a whole, rather than of the agent that implements the project. Social analysis differs from the private analysis in terms of (i) the breadth of the identification and evaluation of inputs and outputs, and (ii) the measure of costs and benefits. Social CBA considers the costs and benefits which accrue to the society as a whole.

Main steps of application:

1. Event, project or policy definition - describe the event, project or policy in sufficient detail in order to be able to determine the relevant benefits and costs.
2. Identification of relevant project impacts - tangible and intangible impacts.
3. Physical quantification of relevant impacts - physical amounts impacts (e.g. in man-days of labour, tons of CO_2, etc.), and identifying when they will occur.
4. Monetary valuation of relevant impacts – valuing all costs and the benefits in monetary units.
5. Discounting of costs and benefits - convert them into their present value.
6. Calculating the CBA performance indicators – main indicators are net-present value, benefit-cost ratio, internal-rate of return.
7. Performing sensitivity analysis - examining how the outcome of the cost-benefit analysis changes with variations in inputs, assumptions or the setup of the analysis.

Strengths:

- Based on well-understood theoretical foundations
- Has a built-in standard for value (in monetary terms)
- Only includes benefits that are corresponding to beneficiaries, which actually value the impact
- Because all CBA studies share a common methodology, lessons learned in one study can be easy transferred to other studies.
- Better adopted to be used in benefit transfer - to estimate benefits in one situation by extrapolation or interpolation from previous studies of similar situations

Weaknesses:

- Limited only to impacts that can be measured in monetary terms
- Strong influence on the results of the selected CBA parameters (e.g., discount rate, project duration, costs and benefits considered)

More information:

Technical report: Methods and tools for socio-economic assessment of goods and services provided by Mediterranean forest ecosystems. Project Report for Component 2 of the project "*Optimized production of goods and services by Mediterranean forest ecosystems in the context of global changes*", pages 29-38.

Further reading:

EC 2002. Guide to cost-benefit analysis of investment projects.

http://ec.europa.eu/regional_policy/sources/docgener/guides/cost/guide02_en.pdf