Chapter 8
Assessing the Economic Aspects of Landscape

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Abstract There are many economic aspects associated with landscape. Firstly, landscape is an "externality", as the economic activities involving the use and transformation of landscape have different effects and repercussions on the same; secondly, landscape, especially in modern society, is seen more and more as a limited resource, and is therefore perceived as an "economic good". In consideration of these assumptions, the current chapter will examine the main indicators used in literature to assess the economic aspects of landscape, with an interpretation on the basis of two major approaches to analysis: the "economic value" of landscape and the "economic strength" of landscape. Finally we will propose a set of indicators based on the DPSIR model on two different scales for monitoring macro transformations (regional scale) and the following in-depth study (local scale).

Keywords Total Economic Value • Externalities • Economic analysis • Evaluation

8.1 Principles and Definitions

There are many economic aspects associated with landscape. The economic activities related to the use and transformation of landscape have various effects and repercussions on the same; according to the literature in the field of economic analysis this is tantamount to saying that landscape is a (positive or negative) externality (Marangon and Tempesta 2008). In general terms, externalities are defined on the basis of the effects (favourable or unfavourable) on the production or consumption of one person by the production or consumption of another, without there being any kind of monetary transaction between the two to balance the costs or benefits of these effects.

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Furthermore, landscape, especially in modern society, is seen all the more as a limited resource. From the point of view of economic analysis, this is the same as saying that landscape can be considered an "economic good", in other words a good available in an insufficient quantity to meet requirements for the same, and for which there is a problem of efficient allocation of resources, guaranteed or not as the case may be by the spontaneous actions of the market (Santos 1998).

In consideration of said characterization, the use of evaluation tools to estimate the value of landscape can be explained on the basis of two main themes. First and foremost we must have tools to establish and assess the foreseeable benefits of certain actions involving the use and transformation of landscape. Secondly, techniques must be established for the assessment of the effectiveness and efficiency of public expenditure for interventions on landscape.Therefore landscape assessment can be translated into economic indicators used to draw up policies for the protection and requalification of landscape.

Indicators have only recently been used in the assessment of the economic aspects of landscape, and are still subject to development. Available publications on the subject indicate two main approaches in the study of economic landscape indicators. The first, more experimental approach, refers to the so-called "economic value" of landscape (Marangon and Tempesta 2008; Marone 2007). According to this approach, the value of landscape is generally established by the so-called existence value, theoretically unrelated to the benefit each person could obtain from a resource, substantially a value closely associated with the many functions it may have for man. In this perspective, landscape has a historical, cultural, recreational, panoramic and aesthetic value; it represents a value for the spirit, for its contribution to biodiversity and ecosystems, security and stability, the production of goods, and employment (Reho 2007).

These aspects/functions of landscape refer to various parties with a vested interest: for farmers (in the case of farmland) and rural communities it is a place to live and work; for society it is a recreational place; but landscape also provides specific environmental services associated with maintaining biodiversity and ecosystems, etc., of interest for generations both present and future.

With the first approach, there are two types of landscape demands (and components of the value).The first demand derives from the tendency of people to try and pass part of their time in more pleasant or more interesting environments from an aesthetic and perceptive point of view. Therefore, the quality of landscape influences the real estate market and recreational behaviour, while a second type of landscape demand is related to the need to protect cultural heritage in its various forms.

A second, more consolidated, approach, that has been called "economic strength" (Nordregio 2000), establishes a connection between the value of landscape and the contribution of the same to the economic system of reference. Therefore, this involves assessing landscape on the basis of the effects that utilization and transformation have on the economic system. These effects are connected, for example, with an increase in tourist flow deriving from the implementation of policies for landscape development of a site or job losses in the agricultural sector as a result of financial measures implemented to support agricultural production of specific value for landscape.

8.2 A Review of Economic Landscape Indicators

The search for specific indicators able to represent the economic aspects of landscape is used in a recent and quite expertimental literature.

The OECD (2001b), as part of its activities associated with the assessment of agricultural policies, lists a series of indicators for landscape assessment, including also some indicators based on economic value.

These indicators were used and studied in depth in a recent Italian study (Marangon and Tempesta 2008), with a precise classification of economic indicators, applicable assessment techniques, and references to specific studies of the past.

In particular, in the authors' opinion, the value of landscape is attributable to the benefits produced by the same. In this sense, the categories of benefits that landscape can produce are associated with the following aspects:

1. Benefits from direct non-extractive use, in other words when a person uses an area with an attractive landscape for recreational purposes. To establish this value, the importance of landscape essentially depends on the type of recreational activity;
2. Benefits from indirect use associated with owning a home in a certain area with an attractive landscape;
3. Benefits from the non-use of the landscape due to the conservation of historical-cultural heritage.

We must emphasise that the use of these indicators is dictated by the availability of very specific data and information, which can only be obtained through direct interviews and surveys examining the benefits produced by landscape from the point of view of potential users (inhabitants or tourists for example). With this approach, the indicators relevant to the value of landscape can substantially be divided into monetary and non-monetary indicators.

For non-monetary indicators, according to Marangon and Tempesta (2008), the result in quantitative or qualitative terms depends on the criteria used in the various fields of interest (with reference to diversity, connectivity, etc. from an ecological point of view, visual quality, complexity, coherence, mystery, etc. from a perceptive point of view, etc.).

There are many publications on the question, from a variety of disciplines. The methods of assessment to which these criteria refer are divided into objective methods (indirect, historical for example) and subjective methods (direct, visual perception for example) by convention. The first are based on the opinions of experts in the assessment of material and formal aspects; the second are based on the level of satisfaction of the community of users in relation to the more intangible aspects of landscape (the identity, symbolic and cultural value, …). The use of these indicators lets us attribute a value to landscape to draw up policies, and comprehend the level of satisfaction in landscape and transformations by society (Tempesta 2006).

As for monetary indicators however, there are some methods that can provide an economic assessment of value for landscape (Stellin and Rosato 1998). These methods can be divided into two major categories, depending on whether they are based on the costs to bear for producing and maintaining the asset, or on the demand of the same asset.

Therefore, we have:

- Methods based on supply analysis (costs)
- Methods based on demand (benefits)

In other words, the monetary value of landscape refers to two main categories of indicators relevant to:

- the cost to maintain and develop certain landscapes;
- the willingness to pay to use a certain landscape, or accept compensation for not using the same.

The analyses of the cost/opportunities for alternative landscape and cultivation assets and the quantification of the costs necessary for the conservation of landscape (defensive expenditures) belong to the first group. The assessment of the benefits produced by the landscape, which can be calculated using methods based on the stated preferences (the willingness to pay to keep a certain landscape intact for example) or on revealed preferences (travel costs to use a certain landscape for example) belong to the second.

Table 8.1 contains a classification of the indicators available for the assessment of the economic value of landscape.

Table 8.1 Economic value of landscape: indicators for assessment. (Source: Marangon and Tempesta 2008)

Assessment methods				Economic indicators
Non-monetary				Average score of landscape as a whole Average score of single landscape element
Monetary	Based on demand (benefits)	Revealed preferences	Travel costs	Recreational benefits per hectare for the single elements of landscape or as a whole
			Hedonic pricing	Variation in housing price per m^2 with reference to the overall quality of landscape or visibility of single elements
		Stated preferences	Contingent valuation	Willingness to pay per hectare to maintain or improve landscape as a whole
			Choice experiments	Willingness to pay per hectare for each single landscape element
	Based on supply (costs)	Cost/opportunities		Reduction per hectare of income per unit to increase landscape quality
		Defensive expenditures		Costs for the conservation of single elements or the landscape as a whole

Box 8.1 Estimate of the Landscape Value Using the Contingent Valuation Method (Verbič and Slabe-Erker 2009) The Contingent Valuation method was applied to estimate willingness-to-pay for the implementation of a plan for the development and conservation of the Volcji Potok landscape area in Slovenia. In particular, this is chiefly an agricultural area currently in a condition of degradation/abandonment, which the landscape plan would help preserve and reorganize, making the area more attractive for tourists.

The Contingent Valuation method was applied in various steps:

1. Data collection
   The sample used in the estimate consisted of 312 individuals, classified as inhabitants and tourists. The interviews held with the sample aimed to establish the willingness-to-pay (WTP) for the realisation of the development scenario of the area in question over the next 5 years.

Table 8.2 Results of the regression model. (Source: Verbič and Slabe-Erker 2009)

Variable	Description	Regression coefficient
CONSTANT	Regression function constant	−275.20
INCOME	This variable represents the monthly income level of the respondent	3.021
CONSC	The variable reflects the conscientious respondents, who place natural and cultural heritage conservation for current and future generations ahead of their momentary life standard	569.83
DAMAGE	The variable takes into account if the individual perceives the size of damage to the area due to unscheduled development as very large	238.48
HERITAGE	The variable represents the value attributed by the respondent to natural and cultural heritage	518.03
FUNCT	The variable represents the value attributed by the respondent to the functional characteristics of the area (cycle paths, footpaths..)	657.50
VALSCL	The variable expresses the number of values embodied in the area's environmental goods that the respondent deems important	154.89
PROTEST	The variable takes into account the fact that an individual may think the implementation of the targeted development scenario should be financed by someone else	−204.99

Other parameters of the regression model

Dependent variable	WTP
n	312
s_e	899.70
R^2	0.420
F(7,304)	24.65
p(F)	0.000

2. Data elaboration
   The data collected was elaborated using a regression model. Table 8.2 shows the regression coefficients obtained; these coefficients indicate the contribution of the various elements in the model used to calculate the final WTP. As we can see, the most significant element in the formation of the WTP refers to the practical characteristics of the area such as, for example, the presence of cycle paths, footpaths and other features attractive for tourists (FUNCT variable). Furthermore, great importance is attributed to the conservation of natural and cultural heritage (CONSC variable).

The WTP value calculated with the regression model was corrected using more sophisticated estimates to obtain a final value indicating a willingness-to-pay per individual equal to 419 SIT/month/individual (equal to roughly 1.75 €/month/individual). Multiplying the figure obtained by the number of residents and tourists in the area (19,332) and calculating the value for one year, the result is a willingness-to-pay equal to 97.4 million SIT/year (roughly 406,000 €/year). Finally, the willingness-to-pay value for the development period of the plan (5 years) is equal to 486.8 million SIT (roughly 2 billion €).

Despite the many difficulties involved in the application of calculations for the proposed indicators (monetary in particular), the same certainly provide a major contribution in assessing demand and supply for the landscape good. The use of these indicators can therefore be a useful support in the development of landscape policies, providing information on the importance attributed to the same by the local population, and also a trade-off between costs and benefits associated with the management of a certain landscape.

The approach used to establish landscape value based on the contribution of said landscape to the economic system of which it is part ("economic strength") refers to more consolidated publications on the theme of assessment of the economic structure and performance for a certain area (Eser 1999; Nordregio 2000).

With this approach the indicators are used for the assessment of agro-environmental policies and refer to interscalar type applications ranging from a national level (assessment of economic performance in the agro-environmental sector of the various member states of the European Union) to a local level (assessment of the effects of financial measures to support single rural enterprises).

It must be said that, unlike the first approach, this approach does not explicitly refer to the theme of landscape, but rather to a series of policies and actions in the territory which envisage, amongst other things, also interventions for the protection and reclamation of landscape.

This approach is usually followed in Rural Development Programmes promoted by the European Union where the aim is to assess and test the effectiveness of public expenditure to reach planned goals.

The main references to this approach are the indicators of the PAIS project—*Proposal on Agri-Environmental Indicators* (Landsis et al. 2002) and the CMEF model (*Common Monitoring Evaluation Framework*), recently implemented by the European Commission (2006) to assess Rural Development Programmes.

Table 8.3 Themes of reference for PAIS project indicators

Quality of life and social wellbeing	
	Environmental themes
	Availability of services (health, education, local government)
	Housing
	Safety
	Income and deprivation
Economic structure and performance	
General	Sectoral shares
	Enterprises
	Investment
	Labour force attributes
	Performance and competitiveness
	Business infrastructures
	Single industry dependence
Primary sector	Agricultural multifunctionality
	Diversification and productivity
	Financial resources
Tourism sector	Physical features of consumption and supply
	Employment features
	Economic repercussions
Demography	
	Population density
	Change and structures
	Commuting and migration patterns
	Cultural issues

In particular, the PAIS project proposes a set of economic type indicators to apply in the assessment of rural development at a European level. These are descriptive social-economic indicators concerning the quality of life; economic structure and performance; population and migration (Table 8.3).

In the CMEF model however, there are a series of indicators that provide a quantitative figure on the contribution of landscape policies (agricultural policies in this case) for the overall economic requalification of the area in question.

The studies on indicators for the sustainable development of the agricultural sector (Wascher 2000; Waarts 2005; EEA 2005; MTT 2002; Van Heuckelom 2004), the cattle-farming sector (Wright et al. 1999) and the forestry sector (MCPFE 1998) also refer to this approach.

Finally, there are a series of studies on landscape assessment through multicriteria analysis, in which economic indicators are used with others for global landscape assessment (Gómez et al. 2003).

8.2.1 Catalogue of Indicators

Below you will find a list of the main economic indicators used for the assessment of landscape in current publications, on the basis of the two approaches described above. The indicators have been organized in brief categories on the basis of the subject (Table 8.4).

Table 8.4 Indicators for assessing the economic aspects of landscape

	Indicator	Source
Economic value of landscape	1. *Value attributed by population* Value attributed by population to farmland Average score of landscape as a whole Average score of single landscape element	OECD 2001b; Marangon and Tempesta 2008
	2. *Recreational benefits* Recreational benefits per hectare for the single elements of landscape or as a whole	Marangon and Tempesta 2008
	3. *Housing prices* Variation in housing price per m^2 with reference to the overall quality of landscape or visibility of single elements	Marangon and Tempesta 2008
	4. *Willingness to pay* Willingness to pay per hectare to maintain or improve landscape as a whole	Marangon and Tempesta 2008
	5. *Income/landscape quality ratio* Reduction per hectare of income per unit to increase landscape quality	OECD 2001b; Marangon and Tempesta 2008
	6. *Conservation costs* Costs for the conservation of single elements or landscape as a whole Maintenance costs of rural buildings	OECD 2001a, b; Marangon and Tempesta 2008
Economic strength of landscape	7. *Value added—agricultural sector* Value added increase for farms receiving support Value added of agricultural sector Value added per hectare Value added per agricultural work unit	Duchateau 2002; European Commission 2006
	8. *Contribution to gross domestic product* Regional GDP percentage attributed to agriculture, forestry and cattle-farming sector	MCPFE 1998; Wright et al. 1999
	9. *Number of farms* Number of farms and cattle-farms Rate at which new enterprises are established in the agricultural and cattle-farming sector	Wright et al. 1999; OECD 2001b; Duchateau 2002; European Commission 2006
	10. *Structure of enterprises* Number of employees on farms and cattle-farms	Wright et al. 1999; Duchateau 2002
	11. *Employment* Net increase in employment Workforce in the agricultural, cattle-farming and forestry sector Salaried labour (hours/year) Rural employment rate	MCPFE 1998; OECD 2001b; Duchateau 2002; European Commission 2006
	12. *Income in the agricultural and cattle-farming sectors* Income pro capita in the agricultural and cattle-farming sector Agricultural income of organic farmers	Duchateau 2002; EEA 2003; Van Heuckelom 2004

Table 8.4 (continued)

	Indicator	Source
Economic strength of landscape (*cont.*)	13. *Income from extra-agricultural activities* Income from tourism sector Percentage of income from off-farming activities	Duchateau 2002; Waarts 2005; European Commission 2006
	14. *Subsidies* Total amount of price supports and subsidies obtained per year Agricultural subsidies per worker	Gómez et al. 2003; Waarts 2005
	15. *Tourism* Number of bedspaces per 1000 inhabitants Accommodation occupancy rate Increase in tourist flow	Duchateau 2002; European Commission 2006
	16. *Farm tourism* Farm tourism enterprises Accommodation occupancy rate in farm tourism	OECD 2001a; MTT 2002
	17. Quality of agricultural production Value of the agricultural production under recognized label/standard	Wascher 2000; European Commission 2006

8.3 Proposal for Economic Landscape Indicators

On the basis of the published indicators described above we will now propose a selection, which will later be studied in depth from the point of view of application.

For the selection of the indicators we decided to adopt some criteria for establishing the significance of the same, taking for granted that all the published indicators meet essential requirements for environmental indicators (see Sect. 2.1.1 of this report).

The criteria used to select the indicators refer to:

- Field of application: the criterion is used to measure the level of technical and operational difficulty and to calculate the indicator (holding ad hoc interviews, static elaborations, …), and to interpret the results;
- Completeness: the criterion indicates whether the indicator considers (from an economic point of view) the various aspects involved in the landscape system in a comprehensive way: not only agricultural structure, but also aspects associated with perception, tourism flows …;
- Specificity: the criterion establishes whether the indicator is essential or not in the economic characterization of landscape.

When selecting the indicators we chose to favour those characterised by completeness and high specificity; furthermore, we decided to consider indicators that can be used in both approaches.

The selection resulted in the following indicators (Table 8.5).

Note that each of the indicators proposed corresponds to a specific scale of application. The scale is closely linked to the availability of source data for calculating

Table 8.5 Indicators proposed for the assessment of economic landscape aspects

Indicator	Scale of application	Dpsir
1. Recreational benefits	Sub-provincial/local	S
2. Housing prices	Sub-provincial/local	I
3. Willingness to pay	Sub-provincial/local	S
4. Conservation costs	Sub-provincial/local	R
5. Tourism flows	Regional/provincial/sub-provincial/local	S/I
6. Value added	Regional/provincial	S/I
7. Employment	Regional/provincial	S/I
8. Amount of subsidies obtained	Regional/provincial	P

the indicators, in order to obtain a legible result. In this way, two different systems of economic indicators are created: one for monitoring macro transformations (regional and provincial) and the other for studying the analyses in-depth (sub-provincial and local level).

Furthermore, as can be seen in the last column of Table 8.5, the proposed indicators guarantee coverage of all the DPSIR model categories.

8.3.1 Presentation of the Indicators Proposed

Below you will find an in-depth presentation of the indicators proposed (Tables 8.6, 8.9, 8.12, 8.13, 8.16, 8.17, 8.18, and 8.19), on the basis of the presentation table used for the study (Sect. 2.2.2). Where possible, the indicators have specific boxes to illustrate their application. The boxes contain some examples related to real cases where the different indicators have been calculated.

Table 8.6 Recreational benefits

Indicator	Recreational benefits
Definition	Assessment of the recreational benefits per hectare deriving from the use of single landscape elements or the landscape as a whole
Description	The calculation of the indicator is based on the travel costs (TC) technique. The travel costs method assesses the recreational value of the territory, analyzing the relationship between the number of visits by a visitor to one or more recreational areas, and the cost born to reach the same. This technique lets us comprehend the benefits deriving from the development of landscape oriented recreational activities (activities in which landscape is the base element such as walking, hiking or cycle tourism, for example …)
Category	Economy
Aims pursuant to landscape	Evaluation
Status/Process	Process

Table 8.6 (continued)

Indicator	Recreational benefits
DPSIR category	State
Typology	Simple
Component variables (if index)	–
Unit of measure	€
Territorial scale of reference	Local
Time scale of reference	Year
Characteristics of use	Scientific
Availability of data source	Direct surveys
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	While there are numerous applications of the travel costs method for analyzing the effects of environmental quality, very few studies have used this technique to analyze the effects of landscape quality Interviews held to gather data and the following elaboration of statistical data make the procedure for calculating the indicator complex and well-organized
Fields/work in which it was used	The literature related to the indicator is quite recent; however it is possible to find some scientific works where the travel costs method has been applied with the aim of assessing the landscape value (for example, Tempesta et al. 2002; Boxall et al. 2003; Bujosa Bestard & Riera Font 2009)

Box 8.2 Estimate of the Landscape-Recreational Value of Forest Landscape Using the Travel Costs Method (Tempesta et al. 2002) This study aims to verify the effects of territorial characteristics and activities on recreational demand. In particular, the territorial context of the research refers to various forest areas in the Friuli Venezia Giulia region of Italy.

The work involved several steps, described briefly below.

(a) Data collection

The first phase of the work refers to the creation of a territorial database containing information on landscape and territorial use, with geo-morphological variables (altimetry, presence of quarries/landslides, …), vegetation variables (arboreal coverage, tree species and relevant surfaces, …), anthropical variables (land use, cultivated surfaces, population density, …) and naturalistic variables (presence of parks, reserves, …). With reference to landscape use, data has been collected on the presence of refuges, high altitude camps and other accommodation facilities for tourists, along with the presence of paths. The information collected was integrated by numerous phone interviews with a sample of 516 people to collect information on their town, and find out how much they spent to take trips to the areas in question, their recreational habits, the accommodation facilities used on trips, their job, family unit and level of education, …

(b) Elaboration and analysis of the results
The data collected was elaborated using regression models to estimate the recreational value of the forest areas. The model developed compares the number of trips with the percentage of overall forest surfaces in the area (Table 8.7). The first column of the table shows the regression estimate, which gives an idea of the importance of the various parameters in determining the frequency of the number of trips; the following columns contain some coefficients used to assess the significance of the parameters obtained in statistical terms.

The influence of the percentage of woodland and grassland shows how important these are to guarantee a pleasant landscape and result, along with other factors, in greater attractive power for the visitor who will be willing to travel great distances to reach districts with a higher distribution of woodland. In consideration of the functional form calculated using the regression model, consumer surplus is equal to 3.22 € per trip. To obtain an initial estimate of the woodland landscape value, the number of trips was simulated with a 1% reduction of the forest surfaces in the areas considered. The result is that the reduction would be equal to 49,060 trips and the recreational benefits would drop by 157,776 €. The landscape value of a hectare of woodland is therefore equal to 58.77 € (Table 8.8).

Table 8.7 Results of the estimate with the initial regression model. (Source: Tempesta et al. 2002)

Variable	Coefficient	Standard error	Statistic t	Significance	Mean
Constant	−2.62	0.1592	−16.4780	0.0000	–
Travel cost	−0.31	0.0000	−37.3600	0.0000	9777.4310
Percentage of woodland surfaces in district	0.03	0.0012	21.0240	0.0000	46.1080
Percentage of meadow surfaces in district	0.03	0.0050	5.2100	0.0000	10.5920
Reason for walks	2.41	0.0573	42.1130	0.0000	0.2980
Spruce-beech, category found mainly in woods	2.29	0.0519	44.0640	0.0000	0.0830
Number of refuges per 100 km^3	0.03	0.0033	8.3350	0.0000	2.5830
Reason for sport trip	1.56	0.0896	17.3990	0.0000	0.0140
Diploma degree	0.83	0.0441	18.8300	0.0000	0.1400
Number of people in family unit	−0.09	0.0170	−5.5730	0.0000	2.8540
Age	−0.01	0.0016	−3.9570	0.0001	56.2430
Reason for hunting trip	0.30	0.0714	4.2630	0.0000	0.0140
LogL	−6758.5010				
Chi square	7781.9600				
Pseudo Chi square	0.5747				

Table 8.8 Simulated effect of a reduction in forest surfaces on the number of trips and the consequent reduction in benefits. (Source: Tempesta et al. 2002)

Current forest surface (ha)	Reduction 1% (ha)	% new woods	Estimate of trips			Tot. Variat. trips	Surplus variat.	
			Current	Reduced	Variat. %		Total (€)	Per ha (€)
268.48	−2,684.80	35.2	2.8514	2.8100	−1.45	−49,060	−157,776	−58.77

Table 8.9 Housing prices

Indicator	Housing prices
Definition	The variation in housing price per m^2 with reference to the overall quality of landscape or visibility of single elements is assessed
Description	The Hedonic Pricing (HP) assessment technique is used to calculate the indicator. This method is based on the hypothesis that the real estate market value depends both on its intrinsic qualities (surface area, state of repair, age, …) and extrinsic qualities (the vicinity of services and town centres, accessibility, the quality of the landscape and air, …). With a significant amount of data we can estimate the relationship between the price and the quality of the landscape
Category	Economy
Aims pursuant to landscape	Evaluation
Status/Process	Process
DPSIR category	Impact
Tipology	Simple
Component variables (if index)	–
Unit of measure	€
Territorial scale of reference	Local
Time scale of reference	Year
Characteristics of use	Scientific
Availability of data source	Direct surveys
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	The data gathered and the subsequent statistical elaboration make the procedure for calculating the indicator complex and well-organized
Fields/work in which it was used	Several scientific works are available in the literature where the hedonic pricing method has been applied with the aim of assessing the landscape value (for example, Tyrvainen 1996; Oueslati et al. 2008; Tagliaferro 2005; Gao and Asami 2007; Kong et al. 2007; Cho et al. 2009)

Box 8.3 Landscape Value Estimate Using Hedonic Models (Tyrvainen 1996) The application aims at evaluating external effects of urban forests associated with housing. Particularly, through the hedonic pricing method the works examines the benefits derived from pleasant landscape, clean air, peace and quiet and screening, as well as recreational activities. The research was developed according to different phases:

1. Data collection
   Apartment sales data (1,006 apartments) were collected in Joensuu, a town of 48,000 inhabitants in North Carelia, Finland. The information on purchase price and apartment characteristics were collected from documents received from local tax authorities. Furthermore, environmental and locality data were measured with respect to each specific house.
2. Elaboration
   According to the hedonic pricing method, the data collected was elaborated in order to explain purchase prices (P). Particularly, the model used the general formula $P = f(A_i, L_i, E_i)$, where A_i is a vector of the apartment characteristics such as size, age and type of construction, L_i is a vector of the locality attributes such as accessibility to town centre, schools and shops, E_i is a vector of the characteristics describing the environmental quality in the housing district including variables such as accessibility to watercourse, recreation areas and relative amount of green spaces. Table 8.10 represents the observed characteristics.

Table 8.10 Housing attributes considered in the model. (Source: Tyrvainen 1996)

Apartment characteristics (A_i)
Apartment size
Number of rooms
Age
Flat roof
Renovations
Facade material brick
Location (L_i)
Town centre
School
Shops
Other public services
Environment (E_i)
Watercourse
Wooded recreation area
Wooded park
Low housing density
Own garden
Traffic noise
Pollution
Low ‘status’ of the housing area

Table 8.11 Hedonic price model (dependent variable: price per square meter). (Source: Tyrvainen 1996)

Independent variable	Coefficient/ implicit price	t-ratio	Coefficient/ implicit price	t-ratio
Low 'status' housing area	−378.23	−7.47	−0.137	−7.547
2 rooms	−332.58	−9.56	−0.118	−9.473
3 rooms	−513.86	−13.56	−0.182	−13.372
4 rooms	−565.7	−11.27	−0.199	−11.027
5 rooms	−620.41	−8.18	−0.229	−8.386
Age	−43.28	−15.73	−0.016	−15.721
Sauna	119.95	3.51	0.039	3.163
Flat roof	−116.92	−4.80	−0.042	−4.791
Distance to town centre	−158.42	−7.32	−0.053	−6.793
Distance to school	42.97	2.01	0.012	1.615
Distance to shop	72.17	2.45	0.023	2.118
Distance to recreation area	−41.78	−1.76	−0.016	−1.896
Distance to 'forest park'	471.46	3.94	0.146	3.39
Green space	7.36	3.37	0.003	3.291
Direct distance to watercourse	−153.97	−4.03	−0.60	−4.391
Distance to nearest beach	40.38	2.03	0.016	2.165
Size of lot	0.23	2.04	1.148×10^{-4}	2.818
Constant	3991.68		8.332	
	Linear model $R^2 = 0.664$		Semilog model $R^2 = 0.651$	

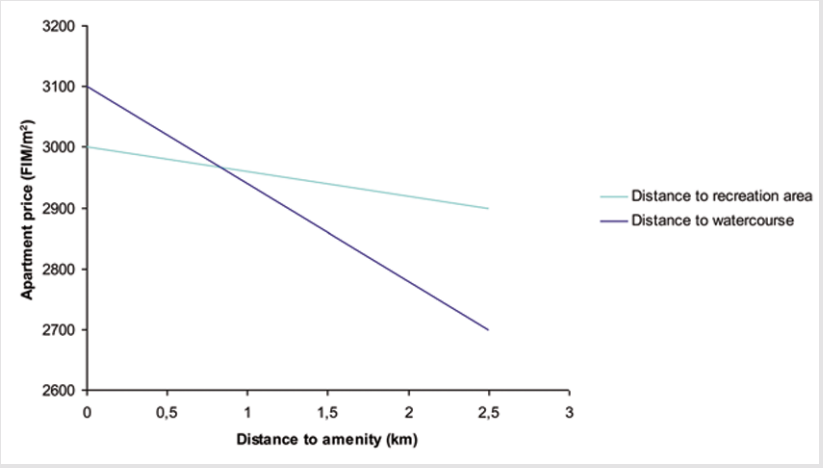

Fig. 8.1 Effects of changes in distance to recreation area and watercourse on apartment price per square meter. (Source: Tyrvainen 1996)

Linear and log-linear hedonic price functions were calculated with multiple regression analysis. Table 8.11 shows the results of the regression models.

3. Results

   Results indicate that urban forests are an appreciated environmental characteristic and that their benefits are reflected in the property prices. Proximity of watercourses and wooden recreation areas as well as increasing proportion of total forested area in the housing district had a positive influence on apartment price. Particularly, Fig. 8.1 shows an application of the estimated implicit prices in evaluation of changes in the environmental quality: the greater the distance to the recreation area and watercourses, the lower the apartment price per square meter.

Table 8.12 Willingness to pay per hectare

Indicator	Willingness to pay per hectare
Definition	The willingness of the users of landscape (inhabitants or tourists) to pay to maintain or improve the landscape as a whole is measured
Description	The indicator can be assessed using the Contingent Valuation method (CV) or the Choice Experiment technique (CE) The CV method is based on the possibility of outlining a hypothetical market for the asset with which the consumer can express their willingness to pay to maintain or improve the quality of the asset, or be reimbursed in the case of qualitative deterioration or less availability. The CE technique is based on an approach used in marketing to reflect consumer preference for the characteristics of new products
Category	Economy
Aims pursuant to landscape	Evaluation
Status/Process	Process
DPSIR category	State
Typology	Simple
Component variables (if index)	–
Unit of measure	€/hectare
Territorial scale of reference	Local
Time scale of reference	Year
Characteristics of use	Scientific
Availability of data source	Direct surveys
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	There are numerous applications for the landscape using CV, while at the moment only a few studies on landscape assets have been carried out using CE. In both cases interviews held to gather data and the subsequent statistical elaboration make the procedure for calculating the indicator complex and well-organized
Fields/work in which it was used	The use of the indicator for the assessment of the landscape value is limited to the scientific literature (for example Bonnieux and Le Goffe 1997; Hanley et al. 1998; Cicia and Scarpa 2000; Sayadi et al. 2009; Verbič and Slabe-Erker 2009)

Table 8.13 Conservation costs

Indicator	Conservation costs
Definition	The costs for the conservation of single elements or the landscape as a whole are assessed
Description	The indicator is based on costs born by private entities or the public administration to prevent the degradation of environmental assets caused by the modification of the environment. To assess these costs we have to identify interventions for the conservation of landscape, the time dedicated to the same and the cost of the means used for said purpose. Once a cost has been attributed to the work (in general the mean hourly salary paid to subjects doing similar work) we can assess the overall maintenance costs of the territory and landscape
Category	Economy
Aims pursuant to landscape	Acknowledgement/Identification/Assessment
Status/Process	Process
DPSIR category	Response
Typology	Simple
Component variables (if index)	–
Unit of measure	€
Territorial scale of reference	Local
Time scale of reference	Year
Characteristics of use	Scientific
Availability of data source	Direct surveys
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	–
Fields/work in which it was used	Some scientific works are available which aim at assessing the costs related to on-farm landscape conservation activities (for example, Tempesta 1993, 1994; Berentsen et al. 2007; Finco and Tempesta 1997)

Box 8.4 Assessment of Expenses for the Conservation of Natural Landscape (Marangon and Tempesta 2008) The results of various studies done in the Italian regions of Veneto and Friuli Venezia Giulia (Italy) in the 1990s to estimate the expenses born for the conservation of natural landscape are shown below. The innovative elements were: (a) maintenance of farm service roads; (b) maintenance of massive walls, dry walls, roadsides and terracing; (c) maintenance of historical artefacts (capitals, drinking troughs …); (d) maintenance of ditches and waterworks; (e) cleaning third party waste; (f) mowing plots of land for aesthetic reasons or safety; (g) cutting back shrubbery on pastures not used for productive purposes; (h) maintenance of non-productive woodland; (i) removal of fallen rocks from meadows; (j) maintenance of fences; (k) maintenance of hedges and trees. The interventions concern both the landscape in the strictest sense, and some functional actions for the use of the territory by visitors, and are therefore relevant for the utilization of the landscape goods.

The results of the specific analysis in the Colli Euganei area (in the province of Padua) are shown in Table 8.14 and Fig. 8.2.

Table 8.14 Average values of the costs borne by farms for territorial maintenance. (Source: Tempesta 1994, reworking)

Type of interventions	Total cost (€)	%	Average cost		
			% of marketable production	Per farm	Per hectare
Roads and road system	15,019.40	22.30	0.54	715.06	30.21
Hydrogeological system	7,182.76	10.70	0.26	341.85	14.07
Historical artifacts	165.19	0.20	0.01	7.65	0.31
Waterworks	13,490.61	20.00	0.51	642.41	25.85
Cleaning waste	45.89	0.10	0.00	2.29	0.08
Mowing	8,455.34	12.60	0.31	402.27	16.60
Maintenance of hedges and trees	15,983.78	23.80	0.60	760.95	31.36
Maintenance of woodland	6,959.44	10.30	0.25	331.15	13.61
Total	67,302.41	100.00	2.48	3,203.63	132.09

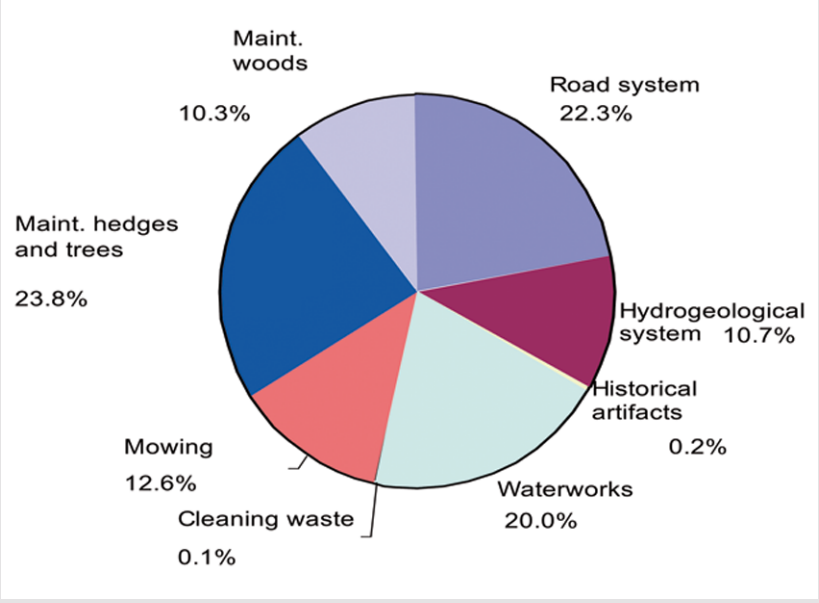

Fig. 8.2 Distribution of the costs borne by farms for landscape conservation. (Source: Tempesta 1994, reworking)

In more general terms, Table 8.15 shows the detailed results of three specific studies carried out to establish the costs borne by farmers for the conservation of landscape in three different territorial contexts: a mountain community, hill country and lowlands. As we can see the costs decrease with the highest in the mountain community (179 €/ha), dropping for the hill country (132 €/ha), and

Table 8.15 Costs borne by farmers for the conservation of rural landscape elements. (Source: Marangon and Tempesta 2008)

Area	Schio (VI)	Colli Euganei (PD)	Udine Plains
Geographical zone	Alp foothills	Wine-growing low hill country	Lowlands
Year	1990	1991	1993
No. of farms	19	21	13
Total per ha (€ 2004)	179.15	132.09	48.17
% marketable production	16.3	2.48	1.76

lowlands (48 €/ha). In the mountain community the maintenance costs of the territory and landscape amount to over 16% of the farm's marketable production. Furthermore, the composition of the costs differs on the basis of the zone: in the mountain community the costs for mowing meadows for aesthetic purposes, the maintenance of woodland and non-productive meadows are particularly high; in hill country and the lowlands there are more interventions for the conservation of the waterworks, hedges and of the inter-ponderal roads.

Table 8.16 Tourism flows

Indicator	Tourism flows
Definition	The increase in tourism flows is assessed in a specific area of reference
Description	The indicator is based on the variation in arrivals and tourists presences measured in a specific territorial area in a certain temporal period of reference
Category	Economy
Aims pursuant to landscape	Evaluation
Status/Process	Process
DPSIR category	State/Impact
Typology	Simple
Component variables (if index)	–
Unit of measure	%
Territorial scale of reference	Local (municipal, supramunicipal), provincial, regional
Time scale of reference	Year
Characteristics of use	Environmental reports, monitoring
Availability of data source	Tourism databases (Regional tourism observers) Arrivals and presences of tourists monitored at a municipal level
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	–
Fields in which it was used	Social-economic reports, Regional tourism observatories

Box 8.5 Analysis of Tourist Movements in the Piemonte Region

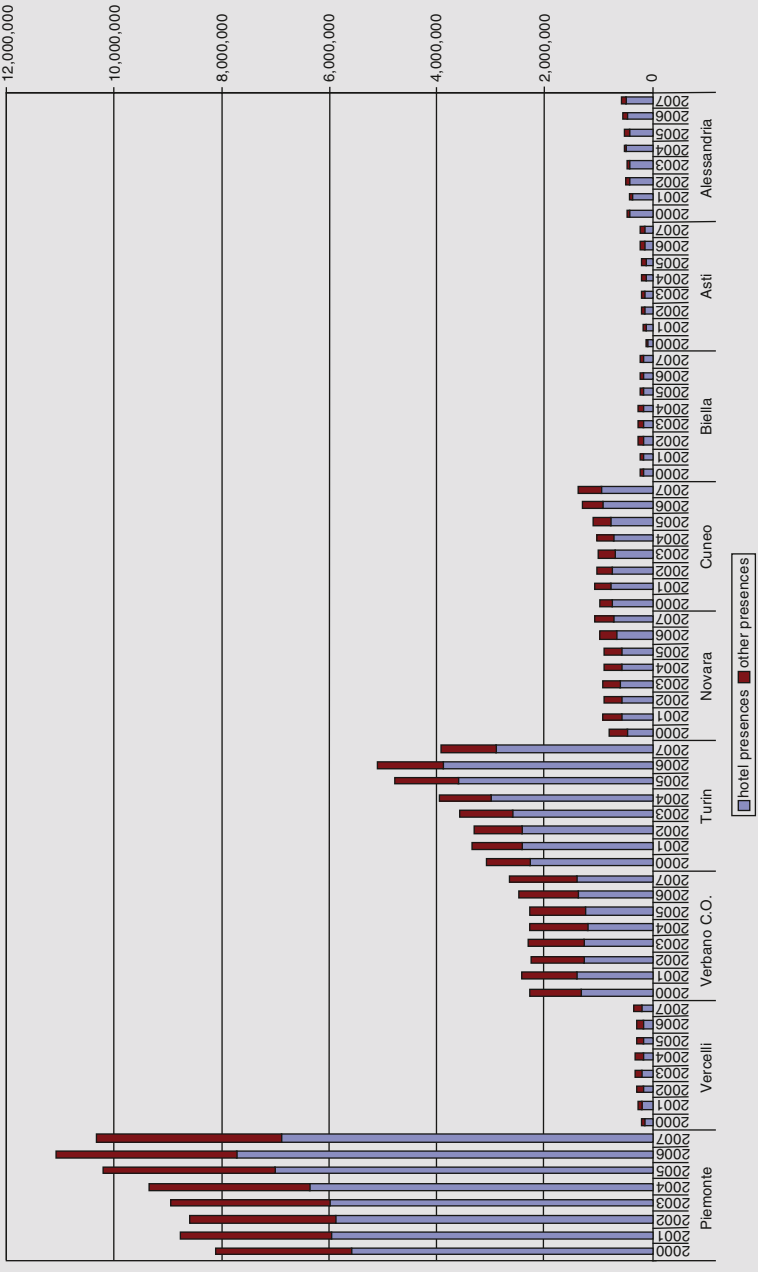

Fig. 8.3 Tourist presences in the Piemonte Region in hotels and other accommodation facilities (2000–2007). (Source: Piemonte in cifre 2007, reworking)

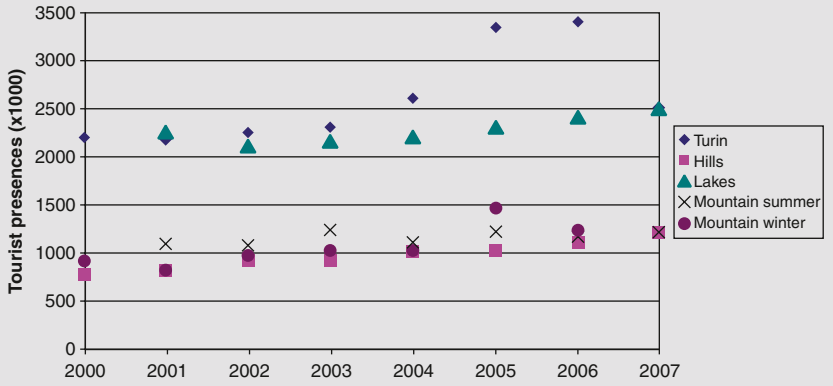

Fig. 8.4 Tourist presences in the Piemonte regional territory in various geographical areas (2000–2007). (Source: Regional Tourism Observatory and Piemonte in cifre 2007, reworking)

Some data on tourist movements in the Piemonte Region of Italy is presented. On the basis of the data, we can examine the distribution of the presences in the various provinces and the accommodation structures used (hotels and other).

The elaborations of the data (Fig. 8.3) show that in general the movements on the regional territory have a positive trend, with a growth rate diversified between hotel presences and presences in other accommodation facilities. The latter, with accommodation in campsites, farm tourism enterprises and similar, is associated in particular with forms of "slow" tourism and territorial use.

It may be interesting to examine the distribution of tourist presences in the various geographical areas of the region (Fig. 8.4). The elaboration of data from the Regional Tourism Observatory shows that the hill country, combining the beauty of landscapes with the food-and-wine offer, represents the destination with the highest rate of growth in the regional territory. This is also evident in the following values from 2007, calculated in relation to 2006: +7.2% arrivals (529,953) and +4.6% presences (1,221,741).

Furthermore, the data on the tourist sector can be used to create thematic maps, to show the geographical distribution of the phenomena. The example in Fig. 8.5 indicates the data on the tourist sector in the Piemonte Region.

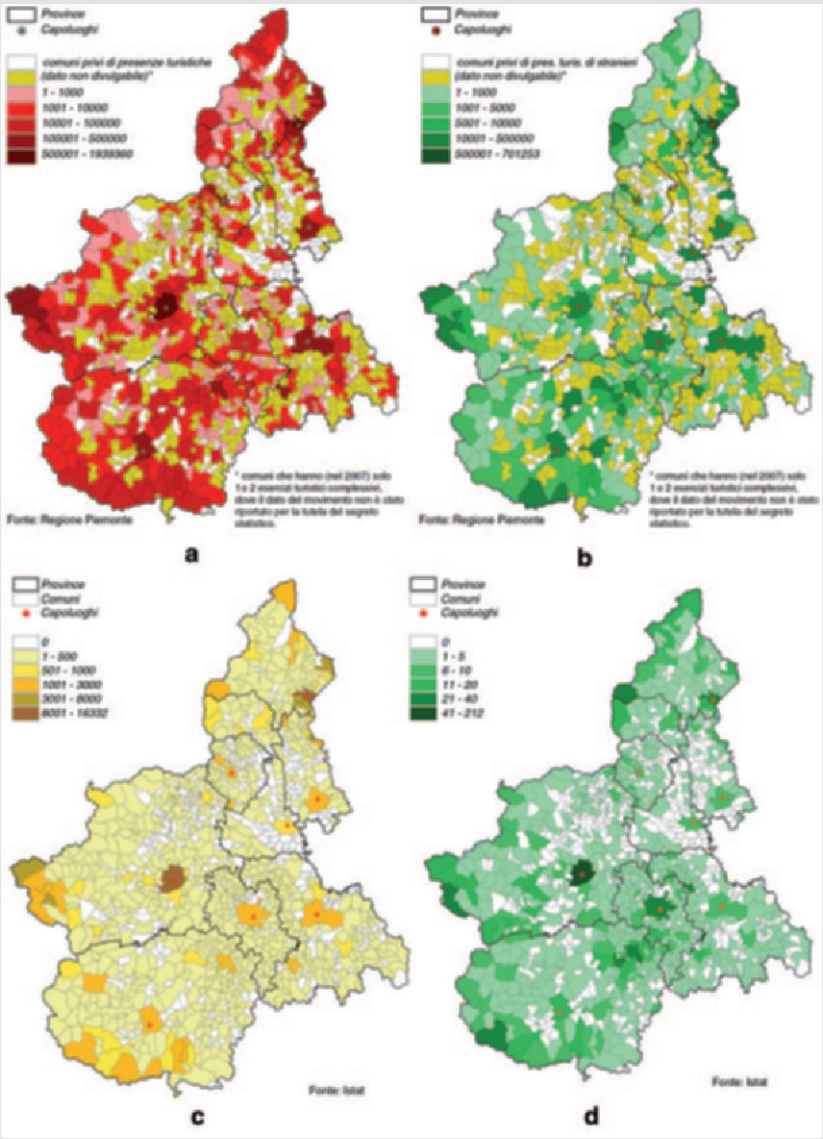

Fig. 8.5 Examples of thematic maps representing the data on tourist flows in the Piemonte Region concerning the national tourist presences (**a**), the international tourist presences (**b**), the number of bedspaces in hotels (**c**) and the number of bedspaces in other accomodation structures (**d**). (Source: Piemonte in cifre 2007)

Table 8.17 Value added

Indicator	Value added
Definition	The development of economic sectors connected with landscape is assessed (typically agriculture and tourism) using an established net value added figure
Description	As for the agricultural sector, the indicator calculation is based on the net variation in the established value added for any agricultural product of value for landscape subsidized with specific financial instruments As for the tourism sector, the indicator calculation is based on the net variation of the established value added in the enterprises of that economic sector in a specific area of reference
Category	Economy
Aims pursuant to lanscape	Evaluation
Status/Process	Process
DPSIR category	State/Impact
Typology	Simple
Component variables (if index)	–
Unit of measure	€
Territorial scale of reference	Provincial and regional
Time scale of reference	Year
Characteristics of use	Monitoring, social-economic reports
Availability of data source	Direct surveys and social-economic databases
Method of representation	Thematic maps, temporal evolution, aerogramme distribution
Other explanatory notes	–
Fields/Work in which it was used	Social-economic reports, ex post assessment reports of Rural Development Plans (for example Regione Umbria 2007)

Table 8.18 Employment

Indicator	Employment
Definition	The employment effects in the economic sectors related to landscape are assessed (usually agriculture and tourism)
Description	The indicator calculation is based on the assessment of the net increase in employment in the agricultural and tourism economic sectors For the agricultural sector, the indicator calculation is based on the net variation in employment (or Annual Work Units, AWU) for agricultural products of value for landscape subsidized with specific financial instruments As for the tourism sector, the indicator calculation is based on the net variation of employment in the enterprises of that economic sector in a specific area of reference
Category	Economy
Aims pursuant to landscape	Evaluation
Status/Process	Process
DPSIR category	State/Impact

Table 8.18 (continued)

Indicator	Employment
Typology	Simple
Component variables (if index)	–
Unit of measure	%
Territorial scale of reference	Provincial and regional
Time scale of reference	Year
Characteristics of use	Monitoring, social-economic reports
Availability of data source	Direct surveys and social-economic databases
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	–
Fields/work in which it was used	Social-economic reports, ex post assessment reports of Rural Development Plans (for example Regione Umbria 2007)

Table 8.19 Amount of subsidies obtained

Indicator	Amount of subsidies obtained
Definition	The entity of the subsidy to enterprises in the agricultural, cattle-farming and forestry sectors is assessed
Description	The indicator calculation is based on the assessment of the total financial instruments used to subsidize agro-sylvo-pastoral production of value for landscape
Category	Economy
Aims pursuant to landscape	Acknowledgement/Assessment
Status/Process	Status
DPSIR category	Status/Impact
Typology	Simple
Component variables (if index)	–
Unit of measure	€
Territorial scale of reference	Provincial and regional
Time scale of reference	Year
Characteristics of use	Monitoring, social-economic reports
Availability of data source	Social-economic databases
Method of representation	Thematic maps, temporal evolution
Other explanatory notes	–
Fields/work in which it was used	Ex ante assessment reports of Rural Development Plans 2007–2013

References

Scientific Literature and Applicative Researches About One Indicator or Category of Indicators

Berentsen PBM et al (2007) Costs and benefits of on-farm nature conservation. Ecol Econ 62:571–579
Bonnieux F, Le Goffe P (1997) Valuing the benefits of landscape restoration: a case study of the Cotentin in Lower-Normandy, France. J Environ Manag 50:321–333

Boxall PC et al (2003) Backcountry recreationists valuation of forest and park management features in wildness parks of western Canadian shield. In: Hanley N et al (eds) The new economics of outdoor recreation. Elgar, Cheltenham

Bujosa Bestard A, Riera Font A (2009) Environmental diversity in recreational choice modelling. Ecol Econ 68(11): 2743–2750

Cho S et al (2009) Amenity values of spatial configurations of forest landscapes over space and time in the southern Appalachian Highlands. Ecol Econ 68:2646–2657

Cicia G, Scarpa R (2000) Willingness to pay for rural landscape preservation: a case study in Mediterranean agriculture. Mattei, Milano

Duchateau K (2002) PAIS: proposal on indicators for landscapes, agricultural practices and rural development at the EU level. 8th IWG.AGRI Seminar, Chateau de la Muette, Paris, 21–22 Nov 2002

EEA European Environmental Agency (2003) Environmental indicators; typology and use in reporting. EEA internal working paper

EEA European Environmental Agency (2005) Agriculture and environment in EU-15: the IRENA indicator report. http://reports.eea.europa.eu/eea_report_2005_6/en/EEA_report_6_2005.pdf. Accessed 5 Oct 2009

Eser TW (1999) Economic strength. In: Nordregio, Study Programme on European Spatial Planning. Spatial criteria and their indicators

European Commission Directorate General for Agriculture and Rural Development (2006) Handbook on common monitoring and evaluation framework. Draft guidance document

Finco A, Tempesta T (1997) Agricoltura e assetto paesaggistico nella pianura tra Tagliamento e Isonzo. In: Tempesta T (ed) Paesaggio rurale e agro tecnologie. Angeli, Milan

Gao X, Asami Y (2007) Effect of urban landscapes on land prices in two Japanese cities. Landsc Urban Plan 81:155–166

Gómez-Sal A, Belmontes JA, Nicolau JM (2003) Assessing landscape values: a proposal for a multidimensional conceptual model. Ecol Model 168:319–341

Hanley N et al (1998) Using choice experiments to value the environment. Environ Resour Econ 11(3–4):413–428

Kong F et al (2007) Using GIS and landscape metrics in the hedonic price modelling of the amenity value of urban green space: a case study in Jinan City, China. Landsc Urban Plan 79:240–252

Landsis g.e.i.e. et al (2002) Proposal on Agri-Environmental Indicators PAIS. Project summary. http://web.ccdr.alg.pt/sids/indweb/imagens/docs_extra/Outrosdocs/PAIS.pdf. Accessed July 2008

Marangon F, Tempesta T (2008) Proposta di indicatori economici per la valutazione del paesaggio. Estimo Territorio 5:40–55

Marone E (ed) (2007) Il paesaggio agrario tra conservazione e trasformazione: valutazioni economico-estimative, giuridiche ed urbanistiche. Atti del XXXVI incontro di studio Centro di Studi di Estimo e di Economia Territoriale CeSET, Catania, 10–11 Nov 2006. Firenze University Press, Firenze

MCPFE Ministerial Conference on the Protection of Forest in Europe (1998) Pan European criteria and indicators for sustainable forest management. Third Ministerial Conference on the Protection of Forest in Europe, 2–4 June 1998. Lisbon, Portugal

MTT Agrifood Research Finland (2002) Agri-environmental and rural development indicators: a proposal. Jokionen, Finland. http://www.mtt.fi/met/pdf/met5.pdf. Accessed 5 Oct 2009

Nordregio (2000) Criteria for spatial differentiation. In: Study Programme on European Spatial Planning (SPESP). Final report

OECD Organisation for Economic Co-operation and Development (2001a) Multifunctionality—towards an analytical framework. OECD, Paris

OECD Organization for Economic Co-operation and Development (2001b) Environmental indicators for agriculture 3. OECD, Paris

Oueslati W et al (2008) Hedonic estimate of agricultural landscape values in suburban areas. 12th Congress of the European Association of Agricultural Economists, Ghent, 26–28 Aug 2008

Piemonte in cifre (2007) Annuario statistico regionale. http://www.2007.piemonteincifre.it/set_i.html. Accessed 14 Dec 2009

Regione Umbria (2007) Valutazione ex post del Piano di Sviluppo Rurale 2000–2006
Reho M (2007) La costruzione di indicatori per la valutazione del paesaggio. Diversi contesti di domanda. In: Castiglioni B, De Marchi M (eds) Paesaggio, sostenibilità valutazione. Quaderni del Dipartimento di Geografia, Università degli Studi di Padova
Santos JML (1998) The economic valuation of landscape change: theory and policies for land use. Elgar, London
Sayadi S et al (2009) Public preferences for landscape features: the case of agricultural landscape in mountainous Mediterranean areas. Land Use Policy 26:334–344
Stellin G, Rosato P (1998) La valutazione economica dei beni ambientali. Città Studi, Torino
Tagliaferro C (2005) La stima del valore economico del paesaggio rurale tramite modelli edonici spaziali. Il caso di Massalubrense. Riv Economia Agraria 3:577–602
Tempesta T (1993) La valutazione del paesaggio nella pianificazione territoriale. In: Franceschetti G, Tempesta T (eds) La pianificazione rurale del Veneto negli anni ottanta. Unipress, Padova
Tempesta T (1994) I servizi ambientali del settore primario. In: Prestamburgo M, Tempesta T (eds) Sistemi produttivi, redditi agricoli e politica ambientale. Risultati di una ricerca del parco regionale dei Colli Euganei. Angeli, Milano
Tempesta T (2006) Percezione e qualità del paesaggio. In: Tempesta T, Thiene M (eds) Percezione e valore del paesaggio. Angeli, Milano
Tempesta T, Visintin F, Rizzi L, Marangon F (2002) Il valore ricreativo dei paesaggi forestali. Riv Economia Agraria 4:637–680
Tyrvainen L (1996) The amenity value of the urban forest: an application of the hedonic price method. Landsc Urban Plan 37:211–222
Van Heuckelom M (2004) Framework for assessing sustainability levels in Belgian agricultural systems. SAFE annual report 2003. Scientific report, Brussels. http://www.geru.ucl.ac.be/recherche/projects/Safe/index.html. Accessed 5 Oct 2009
Verbič M, Slabe-Erker R (2009) An econometric analysis of willingness-to-pay for sustainable development: a case study of the Volčji Potok landscape area. Ecol Econ 68(5):1316–1328
Waarts Y (2005) Indicators for the quantification of multifunctionality impacts. Series of reports of the FP6 research project MEA-Scope 4. European Centre for Nature Conservation, Tilburg
Wascher DM (ed) (2000) Agri-environmental indicators for sustainable agriculture in Europe. European Centre for Nature Conservation, Tilburg
Wright IA et al (1999) A protocol for building the ELPEN livestock policy decision support system. MLURI, Scotland

Web Sources

ECNC European Centre for Nature Conservation. http://www.ecnc.nl/
EEA European Environmental Agency. http://www.eea.europa.eu/
European Commission Directorate for Agriculture and Rural Development. http://ec.europa.eu/agriculture/index_en.htm
MTT Agrifood Research Finland. http://www.mtt.fi/english/
OECD Organization for Economic Co-operation and Development. http:// www.oecd.org/
SPESP Study Programme on European Spatial Planning. http://www.nordregio.se/spespn/welcome.htm