

Chapter 3

Indicators Used for Landscape

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Abstract Each landscape assessment model selects some aspects, component and profiles of interpretation. The chapter provides a state of the art framework, comparing the proposed systems of assessment and the indicators in scientific publications and in international bodies documents. The attention is focused on the categories of indicators: historic, ecological, perceptual, land use and economic are the landscape dimensions which are chosen for the subsequent chapters and proposals.

Keywords Categories and types of indicators • Functions of indicators • European studies on indicators • Landscape model

3.1 Categories of Indicators Traditionally Used in Different Operative Conditions and Studies

Landscape study is an interdisciplinary activity to such an extent that, in consideration of the many disciplines dealing with the same, we can consider the theme of “sectorial landscapes”: landscape as a system of ecosystems, a system of signs, a palimpsest of traces of history, a “scene” or view... After years of discussion in which, each time, one or the other concept prevailed, today the most widespread conviction is that the “sense” of landscape can be found in the intersection of different dimensions. For this reason, assessments concerning the various aspects and, in particular their relations are required.

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The following chapter deals with the aspects to be considered, and those covered by this study. We will review the analytical categories used in the main European studies on the question, favouring those of an international and comparative character (cf. Sect. 2.2). In this panorama we can draw some general conclusions on the categories used, the landscape model in relation to the cultural context, the validity of indicators in relation to geographical context, and on the scale and aims of the use.

With reference to scientific literature and the sets of indicators used by national or regional bodies, it is easy to see that in each country the landscape characters most present in local cultural and scientific traditions, or most pertinent to the characteristics of the area are favoured or emphasized: for example, in Northern Europe the natural and environmental aspects are of great importance, while in Mediterranean Europe there is more emphasis on historical-cultural aspects. This is not the place to ponder the difference between the concepts of “*landscape/landshaft/landschap*” and “*paysage/paesaggio/paisaje*”, but it is important to mention that, currently, the majority of literature and most experiences concerning landscape assessment using indicators pertains to the first area, with the historical-cultural aspects lacking or unsatisfactory (cf. Chap. 5).

Also in methodological proposals which strive for general validity, we can find indicators associated with the specific nature of the territories in question: for example, the indicator “presence (or maintenance) of hedges and linear systems”, which is a characteristic of bocage in Central and Northern Europe, or “presence (or maintenance) of terraces”, pertaining to Mediterranean Europe. These indicators are therefore not universal, but they do have one particular quality: they are extremely sensitive to the value attributed to certain landscapes by the population. Other examples of indicators with a local reference are indicators relevant to perception (cf. Chap. 6): *visual openness* and *perceptual naturalness* are judgement parameters commonly proposed and considered positive for the purpose of assessment; but they reveal the existence of a “beautiful landscape” cultural model based on broad horizons, meadows or fields with rich vegetation, a model which is certainly not universal, and most probably improper with respect to cultural mediators of populations inhabiting territories with a rough morphology where the anthropical signs have a significant connotative value.

The impression left by a review of published indicators is that each of these contains an implicit model of landscape quality, in other words an “implicit project”. It is probably impossible to avoid this model; instead, we can infer that it is legitimate to hope that the indicators are drawn up ad hoc, for each single landscape, with reference to the values expressed by the population and experts. Obviously, this does not exclude the international comparability of the approaches, but makes it obligatory to verify the applicability to the case in question and leads to misgivings about “lists of indicators”, today widely available on the web, from which the unskilled (but sometimes also public decision-makers) feel they can choose freely. In this respect, landscape indicators differ greatly from environmental indicators, which have a higher level of transferability¹.

¹ However, also environmental indicators are not universal: for example, local habits which reflect on legislation, show variations with respect to the tolerance of pollution thresholds and other

This problem can be dealt with in two ways. Firstly, the categories and type of indicators can be identified at a general level, while the indicator can be defined and measured, at a local level, favouring different and specific factors. For example, the preservation of traditional elements of farmland landscape can be measured in one case with reference to the length of the hedges, and in another with reference to the length of dry stone walls, but it can also merge these in one single indicator, for example called “*Length of green linear landscape features maintained and/or restored by farmers: hedges, grass margins in arable fields, stone walls, terraces (...)*”, as proposed by the PAIS project (Landsis et al. 2002). The assessments of a regional or national landscape observatory could function in this way. Secondly, the choice to use just some categories of indicators can be justified by putting them in relation to the landscape values held to be relevant in said context.

Let us now look at some *frameworks* in which landscape indicators are presented. Vallega (2008) first establishes the functions of the indicators:

- *recognition function* (monitoring and measuring conditions and processes);
- *evaluation function* (judgement of the value on the condition, on the process and on the human action in relation to these);
- *orientation function* (supplying indications on the ways in which human action should be implemented).

Also according to the aims of the assessment we have the indicators relevant to “*structure, management, function, value*” (Wascher 2004; Haines-Young and Potschin 2005), *state and change*, or *characterization, transformation and enhancement* (for example “*understanding the assets, caring and sharing, using and benefiting*”, English Heritage 2009). Others prefer to use a division based on the values and functions of the landscape (instead of the indicators) and on the values associated with these: ecological function, social function, economic function (Wascher 2000), *natural value, cultural, use and perception* (Farjon et al. 2009). Or the indicators are divided into indicators that refer to “*landscape as an object*” or “*landscape and perception*” (Wascher 2005). There are many mixed sets, for example the PAIS project (Landsis et al. 2002) lists the following *landscape dimensions: landscape features, human perception, landscape management, landscape conservation and protection*. The Landscape Observatory of Catalunya proposes ten indicators that measure the physical transformation of the landscape, the social perception, and the implementation of landscape policies (Sala 2009). Other sets,

precise aspects. Of landscape indicators, only ecological indicators seem transferable and admit generalizations: the indexes recur (although with many variations) in international literature, and are applied in a wide variety of countries. In reality, it is the interpretation of these indexes that incorporates the “local” point of view, through the knowledge of the expert. Let’s consider the theme of diversity: as a result of its fragmentation, a periurban area may have a high degree of diversity, which depends on the variety of land uses and the length of the perimeters of the patches, but the expert “corrects” the results by applying a landscape quality model, in which the variety is considered good when it consists of patches of a certain type. Methods for estimating the economic value of the landscape also use apparently universal concepts (willingness to pay for a good, attractiveness and recreational value ...): it is easy to see that their declination (and measurement) must allow for models of social behaviour and the locally differentiated use of the space.

while extensive, deal however with one aspect only, for example the ELCAI project (Wascher 2005) concentrates on “*character indicators*”, and the Countryside Quality Counts project on “*indicators of change*” (Baker 2009).

In general, indicators that describe the state of the landscape, and therefore relevant to the characterisation, are more developed in Europe but not homogeneously with respect to all the analytical dimensions and all types of landscape. As mentioned in Chap. 1, landscape indicators were developed for the rural landscape in particular, with the aim of measuring the effects of agricultural policies: this leads to the relevant deformations, whenever one attempts to apply “agri-environmental” indicators to landscape in a broader sense. These in fact favour the ecological aspects and the use of land, disregarding urban landscapes completely. In some of these models, anthropization is definitely considered a negative factor (consider, for example, the land consumption indicator or the index of naturalness)², so the assessment of historical-cultural aspects is based only on the persistence of traditional farmland landscape, or comes into play as a factor of appreciation, in the scenic-perceptual aspects.

The aspects associated with land use (from which the ecological aspects derive also) have the advantage in that they can be analysed using cartographic bases and data present homogeneously on the European territory (Corine Land Cover), in other words on each national and regional territory³. For this reason, some studies concentrate on the possibility of measuring also other landscape dimensions, starting with land use, establishing correlations between elements (for example, between the diversity of use, ecological diversity, visual diversity). Certainly the most common and universally accepted indicators are those relevant to landscape ecology, which also have the advantage of being applicable in every geographical context.

In countries where there is a characterisation of landscapes at a national level (such as Great Britain and The Netherlands), in other words with a complete and homogeneous description of different aspects, it is easier to find structured and differentiated sets of indicators. Obviously, if a description of also the historical-cultural and perceptual aspects is available, it is easier to propose indicators that assess the state and transformations⁴. In other countries, like Italy, the elaboration of indicators must involve the construction of ad hoc databases, or be hampered by considerable restrictions, reducing the complexity of the aspects to those known (see, for example, the recurrence of almost tautological indicators, such as “Designated land areas”) (Malcevschi and Poli 2008).

Not many studies clearly express the scale at which the indicators can be used, although this can be deduced from the context: local, regional, or vaster (national or continental). It is clear that this is an extremely important factor however, to such

² For example, in the Andalusia map of landscapes, the urban landscapes are included in the indicator “urban and unaltered landscapes”, the presence and growth of which is obviously evaluated negatively (Rodríguez and Villar 2009).

³ Cf., the identification of European landscapes in particular, by Alterra: Múcher et al. (2010).

⁴ Studies on the theme of “tranquillity” in England for example: the indicator is made up of numerous indexes, with a broad-ranging cognitive base, associated with national Countryside policies (Haggett et al. 2009).

an extent it influences the type of elements observed. Moving through the scales, are all the aspects into which we break down the landscape analysis equally relevant? Let's consider, in particular, the theme of visual perception: there can be no visual perception of a territory at a regional scale, except with the sum of elements obtained on a detailed scale or as a "mental image", an overall impression, which no longer considers the scenic aspects but rather the theme of social perception and the cultural and identity values associated with the same: as a consequence, the landscape dimension and the methods of analysis must change. Extending the scale weakens the reference to concrete objects and we will observe indirect phenomena; for example, instead of measuring the quality of the landscapes, the "percentage of designated landscapes" is taken as an indicator, a theme which considers the landscape not only as an object, but also in relation to policies. Thanks also to the availability of homogeneous data, the aspects associated with land use and landscape ecology are commonly taken into consideration on a large scale. On this scale, furthermore, the assessments are concentrated on the policies of international bodies, so there are often indicators of response used to measure landscape policies. The differences that can be attributed to the concept of landscape, observed on various scales, are in any case worthy of in-depth study, as yet to be developed.

Another important question concerning landscape indicators is the quantitative or qualitative nature of the measurement. As we will see, there are a considerable variety of approaches, indicators and therefore measurement methods. It is, however, indubitable that establishing thresholds can often represent a problem, every time we have to deal with intangible aspects and symbolic values rather than tangible aspects. In this case, well illustrated by Vallega (2008), despite that fact that there is specific reference to attaining certain goals (such as the ELC goals for example), the thresholds are not necessarily established by the researcher, and can be interpreted by the decision maker: "in other words, it is reasonable to believe that establishing thresholds is methodologically complicated and sometimes even impossible and, when it is possible, a deterministic function cannot be attributed to them as regards to the action".

One last general consideration concerns the level of application of published indicators: in many cases, when we are not dealing with theoretical formulations and proposals, the indicator was applied once only. Obviously this represents a very real limit in the assessment of the effectiveness and in particular the sensitivity to the transformations of the landscape. There are a few exceptions, in other words studies where the researchers deliberately tested a method that had matured in the same places in which it was developed years earlier (for example the methods of analysis on visual preferences in the USA), or studies carried out by institutions and bodies involved in constant research activity and able to plan the research in the long-term (Natural England, English Heritage, Alterra for example)⁵. The continuous evolution

⁵ The Countryside Quality Counts programme (Natural England et al. 2009), which assessed the changes in English landscape over the periods 1990–1998, 1998–2003; or the AAAMPB studies on landscape perception in The Netherlands, carried out on a representative sample of the national population, to be repeated in the future (Farjon et al. 2009).

of landscape research seems to make it impossible to study the same place with the same method twice, although there is often the intention (or proposal) to do so in the future. This is implicit in the Strategic Environmental Assessment (SEA) of plans and programmes that envisage monitoring and several phases of assessment. Therefore we can expect growth in the applicative experiences on all European territories, which should (at least in theory) concern the indicators of transformation and enhancement.

3.2 Indicators in Europe

The construction of a set of indicators that can be used to identify and assess European landscapes in implementation of the European Landscape Convention (CoE 2000) is a subject of debate in the international scientific community. The types of indicators used in key international studies have been listed below, emphasizing how landscape is identified and assessed mainly on an ecological, perceptual and land use scale (Table 3.1); limited attempts have been made to assess the economic value of landscapes, while there is an evident absence of methods for the analysis of historical-cultural values.

The types of indicators used to interpret the landscape are affected by the cultural matrix of landscape policies in north European countries (United Kingdom, The Netherlands, Germany, etc.), the coordinators and/or partners in these studies, who in general focus on the protection of the ecological-perceptual aspects of the countryside for public use (Voghera 2006).

The recent work “Indicadors de paisatge. Reptes i perspectives” of the Landscape Observatory of Catalunya (Nogué et al. 2009) provides some interesting examples on landscape assessment and systems of social, economic and ecological indicators developed in various areas such as Catalunya, Andalusia, The Netherlands, Italy and Great Britain.

Table 3.1 Types of indicators used in studies

Studies	Indicator types				
	Historic	Ecological	Perceptual	Land use	Economic
ENRISK		X	X	X	
OPC		X	X	X	X
ELCAI		X	X	X	
CTN-NEB		X			
IRENA		X	X	X	
SPESP				X	X
DG AGR		X		X	X
EUROSTAT		X	X	X	
EEA 2001		X		X	X
PAIS	X	X	X	X	
MTT		X		X	
APAT		X		X	
Vallega	X	X	X	X	

Of the studies that focus in a systematic way, starting with the collection of methods and applications, on the identification of indicators with a degree of sensitivity to the goals and contents of the ELC, we should mention: the European project ELCAI (Wascher 2005) and the Italian study *Indicatori per il paesaggio* by Vallega (2008).

The ELCAI project (The European Landscape Character Initiative) coordinated by Dirk Wascher, examines landscape assessment techniques in 14 countries, analysing the role of landscape policies at various territorial government levels; it provides a description of the European landscapes as a basis and a common language for the definition of policies at a European level. The study propose a spatial revision of the LANMAP2⁶ (European Landscape Map), a model for the identification and assessment of landscapes that can be used to classify them in “character areas”, through the integration of two consolidated methods of assessment:

- ENRISK (Environmental Risk Assessment of Agriculture in Europe, a study coordinated by the European Centre for Nature Conservation; Delbaere 2005; UNEP 2004) which interprets the state of landscapes and identifies areas at risk and sensitive areas using the following indicators: openness, closeness, coherence and diversity; the approach aims to interpret the vulnerability of the landscapes, above all on an *ecological* scale, by interpreting land use (with Corine Land Cover types⁷) and by using the Shannon index;
- IRENA (based on the DPSIR model and developed by the European Environment Agency to interpret the impact of Agricultural changes on landscape) which uses *ecological, perceptual and land use* indicators such as: diversity, state of the spatial and linear characteristics of the landscapes and types of cultivations, on the basis of LANDMAP2 data (EEA 2003).

In this context the work finally proposes groups of indicators to study (Fig. 3.1):

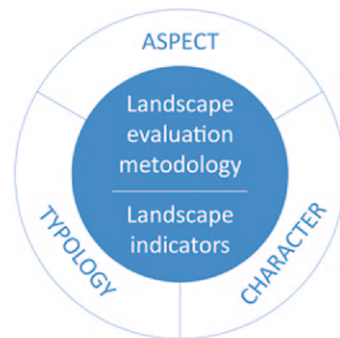


Fig. 3.1 Method developed by ELCAI (Wascher 2005). (Author's layout)

⁶ LANDMAP2 is a model for the analysis of developed landscapes at a European scale on the basis of four parameters focusing on the biophysical characteristics of the landscape: climate, topography, physical characteristics and land use.

⁷ This is based on the indications of the Pan-European Biological and Landscape Diversity Strategy (CoE, Sofia 1995) and the European Landscape Convention (CoE, Florence 2000).

- landscape diversity;
- landscape coherence (on the basis of the prevalence of a type of land use);
- openness and closeness of landscapes.

The study *Indicatori per il paesaggio* (Vallega 2008), with an analysis of conceptual settings—found in international scientific publications—on the characteristics and role of landscape indicators, makes a functional proposal for the assessment of landscape on a subnational scale according to the following themes associated with the ELC:

- biological quality (biodiversity, species at risk, protected species);
- environmental quality (relevant to air, water and land factors);
- urban quality (historic and public green spaces);
- “tangible” culture (historical-cultural heritage);
- “intangible” culture (panoramic views, places of interest, events,...);
- aesthetic quality (perceptual value of the skyline, of damaged landscapes and landscapes under pressure);
- institutional action (effectiveness of steps taken to protect, plan and manage landscape);
- didactics (efficiency of landscape education, information and training);
- social communication (efficiency of landscape communication; landscape in the media).

ELISA (Wascher 2000) is another important international study which identifies agri-environmental indicators useful for interpreting landscape processes also on a European scale, in response to OECD indications. ELISA identifies the following types of indicators:

- environmental and ecological such as the biophysical adequateness of land use, with the need to define a representative territorial system of reference, on various levels (regional/national/European) of landscape analysis;
- perception—openness or closeness, the scenic value of landscape;
- historical-cultural which refers to the presence of goods and/or elements of a historical-cultural value.

The studies of the Statistical Office of the European Communities on Landscape Indicators are of international interest. These, using the IRENA project and with reference to the CEP, propose a landscape classification on the basis of three levels of indicators:

- Level 1, which includes indicators based on the data pursuant to *land use* (for example land occupied by agriculture, silviculture, in conditions of semi-naturalness, or urbanized);
- Level 2, consists of indicators of *landscape coherence* based on the assessment of the degree of fragmentation and ecological diversity, the importance of the characters such as patterns, lines and points, assessing their evolution in time;
- Level 3, which includes the indicators used to attempt to assess *landscape quality and its perception*, through the legibility, diversity and visual variety of the different landscape elements, the specific importance of the cultural identity which can be traced in elements or single characters of the landscape.

The SPESP study (Nordregio 2000) which assessed the effects and impact of the implementation of ESDP—European Spatial Development Perspective (EC 1999), identified *land use and economic* indicators with reference to policies for the protection and enhancement of cultural landscapes, acknowledged as a factor of European identity and diversity. In particular the study focused on:

- identifying indicators relevant to rural cultural landscapes useful for interpreting the quality of the landscapes, identifying areas requiring policies for the management of tourist flows;
- the construction of a method of data analysis and collection, data obtained mainly on a regional and local scale.

In this context, the following indicators, available on a European scale (first and foremost in the EUROSTAT “Regio Database” and “CORINE Land Cover Database”) were identified:

- land use: AP (Agricultural production) which interprets the UAA (Utilised Agricultural Area) percentage;
- economic: Share of farms with a UAA less than 20 ha.

The two indicators provide data on the intensification of production and the concentration of small farms, which can be used to assess rural territories, characterised by non-industrialized production methods and a greater landscape and ecological diversification. Through the integration of the results deriving from AP and UAA with the yearly tourist stays indicator we indirectly obtain indications on the quality of landscapes and their attractiveness.

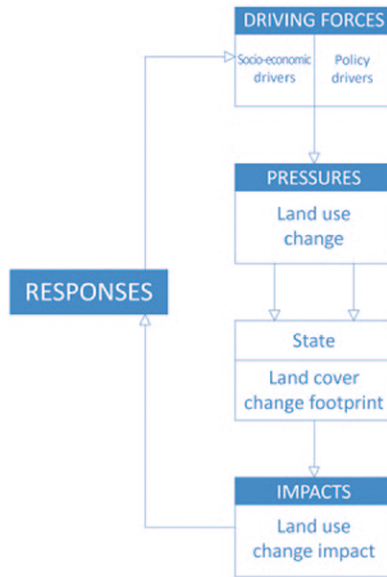
The European Environment Agency (EEA 2001) recently drew up a method for assessing the effects of territorial policies on the environment and landscape, which uses some indicators of performance, useful for putting the pressures and the state of environmental and landscape values in relation (Fig. 3.2); the result is indications for specific regulatory actions on a European (directives and regulations), or national (laws, regulations, restrictions for protection) scale; the method uses:

- *environmental* indicators, useful for interpreting environmental and landscape values with reference to the “past” state;
- indicators of risk, which highlight short-term criticality/sensitivity on a local scale;
- “sector” indicators for assessing the effects of European sector policies with impact on the territory (transportation, agriculture, tourism, etc.);
- indicators of *sustainability*, the expression of an integrated long-term vision of *socio-economic, environmental and landscape* values.

The European PAIS⁸ project (Landsis et al. 2002) identified some agri-environmental indicators (Proposal on Agri-Environmental Indicators) useful for interpreting the landscape dimension of rural territories, divided into the following types:

⁸ The general aim of the PAIS project is to help identify agro-environmental indicators that can be used by the European Commission for the assessment of policies, as indicated in the documents

Fig. 3.2 Type of indicators proposed by the European Environment Agency with reference to the DPSIR model. (Author's layout)



- (a) Landscape features, to interpret the state and changes in the structure of the landscape, in its ecological function, and in current and historic cultural values (Landscape composition, Landscape configuration, Natural landscape features, Historical-cultural landscape features, Present—cultural landscape features (State and Change));
- (b) Human perception, which describes the social perception (visual and aesthetic) of the landscapes;
- (c) Landscape management, with reference to the action taken to protect cultural values (Cultural landscape protection/conservation) and natural values (Nature conservation/protection).

To provide guidelines for rural policies in the period 2007–2013, the Directorate-General for Agriculture and Rural Development (2006) developed some indicators to assess the effects of Rural development plans on the environment and landscape, in accordance with the new Council Regulation (EC) No 1698/2005 of 20th September 2005 on support for rural development; in fact *the regulation* establishes the need to adopt a strategic approach to rural development, based on goals rather than measures⁹, by defining three such goals (Art. 4):

COM(2000)201 and COM(2001)1442. In this context PAIS develops three sets of indicators relevant to: Landscapes, Agricultural policies and Rural development.

⁹ In fact it intends to promote a radical simplification of the implementation of policies, through the introduction of a single financing system and by modifying the programming framework, financial management and control for rural development programmes.

- increasing the competitiveness of the agricultural and forestry sector through renovation, development and innovation;
- enhancement of the environment and natural landscape through territorial management;
- improving the quality of life in rural areas and promoting the diversification of economic activities.

With reference to these goals, the following *ecological and land use* indicators have been identified for the assessment of environmental and landscape inclusion: Land cover, Less Favoured Areas, Areas of extensive agriculture, Natura 2000 area, Biodiversity: Protected forest, Development of forest area, Forest ecosystem health, Water quality, Water use, Protective forests concerning primarily soil and water.

The studies of the Finnish MTT (2002) and the Italian APAT (2003) identify sets of indicators that interpret the landscape from a point of view of biodiversity. MTT Agrifood Research Finland and the University of Helsinki (2002), to assess the possible ecological and territorial effects associated with the reform of the Common Agricultural Policy, identifies four indicators of biodiversity relevant to the rural landscape: the quantity of semi-natural pastureland, the number of endangered species, the endangered species in the rural habitat and the butterfly population. These indicators, applied in the study of the Finnish rural territory, make it possible to monitor the state, pressures and the evolution of biodiversity in the rural landscape on a vast (national) scale, to define strategies and draw up guidelines to stem the reduction of biodiversity in the rural territory (Kuussaari et al. 2004).

In Italy the APAT, through the National Nature and Biodiversity Thematic Centre (CTN-NEB)¹⁰, developed a method for collecting the data for *elaborating indicators of biodiversity* (2003). Landscape is considered part of the group of *Nature and Biodiversity (NaB) indicators*: trends and changes; the effects of climate changes on the environment; protected zones, bogs; forests; landscape; ecosustainable agriculture, genetically modified organisms. A report was drawn up for each indicator to describe the main characteristics (thematic area, denomination, description, Institution of reference, sampling unit, timing, instrumentation, aims of the collection, associated indicators, collection network, users, etc.). This method, while it still fails to consider the elaboration of landscape indicators, interprets the landscape “both as a system of ecosoiaics and as a perceptive and identity ambit”.

¹⁰ The National Nature and Biodiversity Thematic Centre (CTN-NEB) is one of the thematic centres set up as part of the Environmental Information and Control System (SINAnet), on the basis of indications from the APAT with the contribution of the Regional environmental agencies, the regional authorities and the authorities of the autonomous provinces. The CTN was established on the legacy of the previous National Nature Conservation Thematic Centre (CTN-CON) updating the information gathered by the same and developing the knowledge.

3.3 The Indicators Categories Proposed by the Study

As can be seen in the previous paragraphs, each landscape assessment model selects some aspects, components and profiles of interpretation. In general, there are three core themes: nature, culture, and perception.

In short, which aspects of the landscape must or can be assessed, and with which indicators? On the one hand, our proposal derives from theoretical acquisitions on the nature of the landscape, while on the other it derives from the need to provide a response to the European and national legislative and administrative framework.

The first reference is the European Landscape Convention and the subsequent Recommendation CM/Rec (2008)3 of the Committee of Ministers on its application, which establishes the following principle:

B. Recognize the fundamental role of knowledge. The identification, description and assessment of landscapes constitute the preliminary phase of any landscape policy. This involves an analysis of morphological, archaeological, historical, cultural and natural characteristics and their interrelations, as well as an analysis of changes. The perception of landscape by the public should be analysed from the viewpoint of both its historical development and its recent significance (Part I.1).

Further indications in Part II.2.1 *Knowledge of the landscapes: identification, analysis, assessment*:

Action should be taken to: - promote integration of the different knowledge-production approaches to observation of the territory (economic, social, environmental, historic/cultural, perceptual/visual, etc.) (...).

In Italy, which is our case study, the Cultural Heritage and Landscape Code of 2004 (Italian Republic 2004) (modified in 2006 and 2008) indicates the aspects which must be considered to declare a landscape of “notable public interest” (a procedure necessary for the application of national protection): “The proposal is motivated with reference to historical, cultural, natural, morphological and aesthetic values expressed by the distinctive aspects and characters of the buildings or areas considered and by their identity value and quality in relation to the area they are in, which are perceived as such by the populations” (Art. 138).

On the basis of these indications and the international review on the subject, in the following chapters we intend to consider and analyse the landscape indicators on the basis of these profiles of interpretation:

- landscape ecology;
- historical-cultural heritage;
- visual and social perception;
- land use;
- territorial economy.

These aspects include the three main core themes, nature, culture and perception, with the most dynamic aspects (useful for the purpose of monitoring). Indicators have already been developed for some of these categories, while others represent a new research frontier, in particular inspired by the European Landscape Convention (as is the case for social perception and the economic value of the landscape).

In particular, as for the natural aspects, we feel it is of little use to include morphological aspects, which are most certainly instrumental in the characterisation of a landscape but with a lower probability for change, and specifically naturalistic aspects, more pertinent to other types of environmental assessment, while the ecology of the landscape offers a common interpretative paradigm at an international level.

Historical-cultural heritage is understood first and foremost as material manifestations, evidence of the history, and characterizing the identity of a landscape, and secondly as an intangible dimension concerning the aspects of acknowledgement, conservation, and use of resources.

The perception of landscape also concerns two aspects. The first is the scenic-perceptual aspect (in particular visual), associated with aesthetic appreciation but with reference to the material structure of the landscape (for example the relation between morphology and visibility). The second, the intangible dimension, is represented by the type of value society attributes to landscape, with many different values for different social groups. This attribution of value is associated with the social justification of public policies, and is therefore quite relevant.

The study of this last aspect intersects methods of economic analysis: the estimated value that can be attributed to the landscape, in monetary terms (a field of research that have been developed with the specific aim of including the landscape in the economic evaluation of natural resources and environmental goods). Therefore, the economy of the territory in this work includes two aspects: on the one hand the economic value of the landscape, and on the other the contribution of the landscape to the economic system, for example through tourism, or the externality in real estate values, et cetera. The study of the economic aspects is therefore useful both to establish social appreciation and to consolidate political action for landscape, emphasizing the benefits for populations.

Furthermore, the use of the territory includes a series of phenomena associated with land use, which in many cases constitute decisive elements or put pressure on the landscape (for example, soil sealing or certain categories of use, predictive of landscape quality or criticality). The aspects of landscape planning, such as protection or actions of enhancement are considered, which, on the one hand affect the landscape, and on the other can be taken as indicators of social sensitivity or be subject to monitoring.

In the following chapters the indicators relevant to each of these profiles of interpretation will be considered in depth by specialists in the various disciplines, while in the last chapter we will deal with the problem of considering the different aspects in relation to each other (Fig. 3.3).

Each chapter is structured in the following way:

- principles and definitions, presentation of the concepts, traditional studies and approaches, and thematic organization;
- review of published indicators, full list;
- Critical selection and proposal: list of published indicators selected, some of which have been re-elaborated, and new proposals;
- Description of the proposed indicators;
- Boxes illustrating applicative cases.



Fig. 3.3 Categories of indicators proposed by the study. (Author's elaboration)

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