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ANALYSIS OF APPROACHES ON VALUATION OF FOREST ECOSYSTEM SERVICES IN THE PAN-EUROPEAN REGION

In this article, various approaches to assessing forest ecosystem services have been studied. One important aim of the ecosystem assessment is to analyse and as much as possible quantify the importance of ecosystems to human well-being. Valuation is used as a tool that enhances the ability of decision makers to evaluate trade-offs between alternative ecosystem management regimes and courses of actions that alter the use of ecosystems and the services they provide.
The output of the analysis of different approaches and methodologies on FES valuation is to design an interactive table. The table should document the suitability of valuation methods for individual FES (considering benefits and limitations of each method) in a clear, concise and comprehensive way. The table should provide simple orientation within different valuation methods. It should also relatively quickly and clearly propose suitable method, which could be used to value individual forest ecosystem service in a given situation.
The ways of further research could be to develop proposals for the assessment of forest ecosystem services in order to make effective decisions regarding the sustainable use and management of ecosystems.
***Key words**: forest, forest ecosystem services.*

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АНАЛІЗ ПІДХОДІВ З ОЦІНКИ ЛІСОВИХ ЕКОСИСТЕМНИХ ПОСЛУГ У ЗАГАЛЬНОЄВРОПЕЙСЬКОМУ РЕГІОНІ

Ліси є важливими екосистемами, що надають багато переваг суспільству у вигляді товарів та послуг, таких як деревина, продукти харчування, чиста вода, енергія, захист від повеней та ерозії ґрунту, регулювання кліматичних циклів, рекреаційні та культурні цінності. Вони носять назву лісових екосистемних послуг (ЛЕП) і відіграють важливу роль у добробуті людини, роблячи значний прямий і непрямий внесок у розвиток національної економіки та сприяючи екологічній стабільності.
У даній статті проведено дослідження різних підходів до оцінки лісових екосистемних послуг. Однією з важливих цілей даного виду оцінки є аналіз і, наскільки це можливо, кількісне визначення важливості екосистем для забезпечення добробуту людей, з метою прийняття ефективних рішень щодо сталого використання та управління екосистемами. Оцінка є інструмент, що підвищує здатність суб'єктів прийняття рішення, в визначенні компромісів між альтернативними режимами управління екосистемами та курсами дій, що змінюють використання екосистем та послуг, які вони надають.
Оцінка екосистемних послуг може служити джерелом для прийняття рішень на різних рівнях управління: від міжнародних та національних політичних рішень до регіональних та субрегіональних та рішень місцевого планування й проектів. Виклик у кожному випадку полягає в визначенні всіх екосистемних послуг, на які вплине управлінське рішення, і отриманні достатньої інформації для проведення оцінки екосистемної послуги, включаючи зв'язок оцінки змін у наданні послуг з заходами управління змінами добробуту людини.
Оцінка є передумовою для розробки механізмів з отримання винагороди від послуг та створення систем фінансування / стимулювання, таких як плата за екосистемні послуги (ПЕП). ПЕП охоплює різні фінансові механізми, за допомогою яких бенефіціари ЕП платять постачальникові цієї послуги, таким чином пропонуючи стимули для захисту та постачання таких послуг. Оцінка вартості природного капіталу (елементи природного середовища, що забезпечують цінні товари та послуги людям) є основоположним для того, щоб вирішити, як і де слід витрачати кошти на відновлення, підтримку та керувати природним середовищем.
Кожна оцінка лісових екосистемних послуг дійсна лише для конкретної території та визначеного періоду часу, тобто вона повинна бути просторовою та тимчасово явною. Тому висновок аналізу різних підходів та методологій щодо оцінки екосистемних послуг полягає у розробці інтерактивної таблиці. Таблиця повинна документувати придатність методів оцінки для окремих екосистемних послуг (розглядаючи переваги та обмеження кожного методу) чітко, стисло і всебічно. Таблиця повинна надавати просту орієнтацію в рамках різних методів оцінки. Слід також порівняно швидко і чітко запропонувати відповідний метод, який може бути використаний для оцінки індивідуальної екосистемної послуги у певній ситуації.
***Ключові слова**: ліс, екосистема, лісова екосистема, екосистемні послуги.*

Introduction to forest ecosystem services

Forests are important ecosystems delivering multiple benefits for society in the form of goods and services such as wood, food, clean water, energy, protection from floods and soil erosion, regulation of climate cycles, recreation and cultural values. These benefits are known as forest ecosystem services (FES). They play an important role in human well-being, make significant direct and indirect contributions to national economies and contribute to environmental stability.

Following the outcomes of the Seventh Ministerial Conference (Madrid, Spain, 20-21 October 2015), the

Expert Level Meeting held in Bratislava, Slovakia on 11-12 May 2016 approved FOREST EUROPE Work Programme (FE WP) for the period 2016-2020.

The FOREST EUROPE Expert Group on valuation of and payments for forest ecosystem services is established according to the FE WP Action 4.4 «Incorporating the value of forests ecosystem services in a green economy» and its two activities 4.4.1 and 4.4.2 «Promotion of the Pan-European practices on valuation of and payments for forest ecosystem services».

From 1 January 2016, Slovakia has become the «political leader» in the FOREST EUROPE process. In addition to its presidency (shared with Spain), Slovakia hosts a secretariat of the process, the so called Liaison Unit. The Liaison Unit Bratislava is an organisational unit of the National Forest Centre.

The National Forest Centre provides for the forest sector services in the areas of forest research, education, public relations, public procurement of forest management programmes and preparation of supporting materials for their elaboration, technical assistance, management and distribution of forest data and information, and the processing and administration of the National Thematic Map Set on Forests. It comprises four specialised institutes: Forest Research Institute, Institute for Forest Consulting and Education, Institute for Forest Resources and Information, and Forest Management Planning Institute.

At the Madrid Conference, the ministers responsible for forests expressed their commitment to recognise the key role of forest ecosystem services (FES). In the Madrid Ministerial Resolution 1 «Forest sector in the center of a green economy», the ministers committed themselves to:

- Recognise the key role of forest ecosystem services in the contribution of forests to a green economy.
- Promote the exchange of information on methodologies and practices on the valuation of and payments for forest ecosystem services as well as policy approaches to this end.
- Support the development and possible application of common methodologies for the valuation of forest ecosystem services.
- Promote national implementation of strategies and guidelines for dynamic conservation and appropriate use of forest genetic resources under changing climate conditions.

Prior to the Madrid Resolution 1 «Forest sector in the center of a green economy» (2015) essential benefits provided by forests and the importance of the value of forest goods and services had already been recognised in Vienna Living Forest Summit Declaration «European Forests – Common Benefits, Shared responsibilities» (2003), and Oslo Decision «European Forests 2020» (2011). Water related services were addressed in Warsaw Declaration (2007) and Warsaw Resolution 2 «Forest and Water» (2007).

Noting the importance of recognizing the role of FES, the Expert Group continue exploring different approaches to valuation of and payments for FES existing within the pan-European region in order to identify possible methodologies and replicable experience.

In the pan-European region, high importance of this issue is empathised by the former and ongoing work carried under the guidance of different international organisations and initiatives, e.g. joint effort of UNEP/UNECE/FAO on payments for ecosystem services in a green economy [36]; study on valuation and payment approaches for water related FES conducted by UNECE/FAO Forestry and Timber Section; findings from the large EU project NEWFOREX [37]; outcomes of the FORVALUE [38] project coordinated by EFI-EFIMED; COST Action E45 EUROFOREX on valuation of externalities produced by different types of forest in Europe; activities of the Joint Research Centre of the European Commission on analysis of FES and its implementation into Forest Information System for Europe [39]; studies of DG AGRI and DG ENVIRONMENT of the European Commission on valuation and assessment of ecosystem services; The Economics of Ecosystems and Biodiversity (TEEB) aimed to mainstream values of biodiversity and ecosystem services [40]; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services focusing on global and regional assessment of biodiversity and ecosystem services; [41] and many others.

The activity was build on the outcomes of the above mentioned work of organisations, initiatives, former FOREST EUROPE work (e.g. outcomes of the work of the former FOREST EUROPE Expert Group on valuation of FES [42]) and the experience of signatory countries.

The Millennium Ecosystem Assessment (2005) was one of the first important global study on ecosystem services (ES) and its framework is widely accepted and seen as a useful starting point [34], [3], [9]. However, more recently the Mapping and Assessment on Ecosystems and their Services (MAES 2013) framework was adopted by Member States of the European Union. It builds on the findings of the MA and TEEB global initiatives and was further refined as an operational framework at European level.

MAES (2013) defines ES as the benefits that people obtain from ecosystems - the direct and indirect contributions of ecosystems to human wellbeing [32]. The concept «ecosystem goods and services» is synonymous with ecosystem services. The service flow in the conceptual framework refers to the actually used service.

MAES, according to CICES (2013), classifies ES into three groups: Provisioning, Regulating/Maintenance and Cultural services. However, there are also other two international classifications of ES applied according to MA (2005) and TEEB initiatives (2010). Comparison of these main classification schemes was addressed by the former FOREST EUROPE Expert Group on Valuation of Forest Ecosystem Services during 2013-2014, and the results can be found in the FOREST EUROPE Final Report on Valuation of FES (2014).

The simplest version of the conceptual framework for EU wide ecosystem assessment (MAES 2013) links socio-economic systems with ecosystems via the flow of ecosystem services and through the drivers of change that affect ecosystems either as consequence of using the services or as indirect impacts due to human activities in general.

Ecosystems are shaped by the interaction of communities of living organisms with the abiotic environment. Biodiversity - the variety of all life on earth - plays a key role in the structural set-up of ecosystems which is essential to maintaining basic ecosystem processes and supporting ecosystem functions. Ecosystem functions are defined as the capacity or the potential to deliver ecosystem services.

Ecosystem services are, in turn, derived from ecosystem functions and represent the realized flow of services for which there is demand. For the purpose of this framework, ecosystem services also encompass the goods derived from ecosystems. People benefit from ecosystem (goods and) services. These benefits are, among others, nutrition, access to clean air and water, health, safety, and enjoyment and they affect (increase) human wellbeing which is the key target of managing the socio-economic systems. The focus on benefits implies that ecosystem services are open to economic valuation. However, not all benefits to people from ecosystems can be measured in monetary terms. Therefore, it is important to include other values as well, such as health value, social value or conservation value. The governance of the coupled socio-economic-ecological system is an integral part of the framework: Institutions, stakeholders and users of ecosystem services affect ecosystems through direct or indirect drivers of change. Policies concerning natural resource management aim to affect drivers of change to achieve a desired future state of ecosystems. Many other policies also affect these drivers and thus can be added to the framework as they have an impact on ecosystems even though they might not target them at all (e.g. through the construction of buildings or infrastructure, or industrial policy through pollution) [19].

It can be stated, the MAES (2013) framework is successful in integrating the biophysical domain with the socio-economic drivers affecting ES and considers as well the role of biodiversity in ecosystem functions and services, therefore this is a good basis for consideration of European forests in terms of ecosystem service delivery and opportunity.

Valuation of forest ecosystem services

The importance or «value» of ecosystems is viewed and expressed differently by different disciplines, cultural conceptions, philosophical views, and schools of thought [12]. The basic for ES represents natural capital, which is defined by The Natural Capital Committee as «those elements of the natural environment which provide valuable goods and services to people» [23]. One important aim of the Millennium Ecosystem Assessment is to analyse and as much as possible quantify the importance of ecosystems to human well-being in order to make better decisions regarding the sustainable use and management of ES. Valuation is used as a tool that enhances the ability of decisionmakers to evaluate trade-offs between alternative ecosystem management regimes and courses of actions that alter the use of ecosystems and the services they provide [18].

The valuation of ES can provide input for decisions at many different levels [33]. This ranges from national and international policy decisions to regional and subregional decisions and local planning decisions and projects. The challenge in each case is to identify all the ES that will be affected by the decision and to obtain sufficient information to conduct the ecosystem service assessment, including linking the assessment of changes in service provision to measures of changes in human welfare [7].

There are a number of other reasons for undertaking valuation of FES. The most common are as follows [21], [10], [20]:

- to assess (and improve) the overall contribution of forests ecosystems to social and economic well-being,
- to obtain information about the relative importance of FES and preferences for their provision across and from different stakeholder groups and understand how and why stakeholders use forests as they do,
- to assess the relative impact of alternative actions, as a decision support tool,
- to identify potential winners and losers when adopting a certain management alternative,
- evaluating the impacts of environmental policies,
- establishing incentive schemes or markets of FES.

It should be also noted that some kind of valuation is an implicit prerequisite for developing mechanisms to capture benefits of the services and in establishing finance/incentive systems such as payments for ecosystem services (PES). PES covers a variety of financing arrangements through which the beneficiaries of ES pay the provider of those service [13], thus offering incentives for protecting and supplying such services. Assessing the value of natural capital (elements of the natural environment that provide valuable goods and services to people), is fundamental to deciding how and where funds should be spent to restore, maintain and manage the natural environment [23].

A major challenge facing the delivery of the FES is that many of the services provided are not traded in markets, making it difficult to observe their values directly [10]. Many FES accrue to the recipients as public goods. In practice, it's probably more of a continuum. Although, non-market goods may not all be pure public goods, but display some of the characteristics of public goods. They may be enjoyed by any number of people without affecting other people's enjoyment. The problem with public goods is that, although people value them, no one person has an incentive to pay to maintain the good [22], [28], [29], [30], [31].

Also, where these goods and services are supplied to either society or specific groups of users for free or at a price which is below the production costs of equivalent goods and services, forest owners receive little or no monetary incentive to provide them. This can result in declines in both the quality and quantity of these services. Possible solutions include applying regulations to enforce their provision or developing incentive mechanisms (including market-based instruments) which encourage woodland owners to provide them. Therefore, knowledge of how to estimate the economic value of these services is often a crucial step in providing evidence to support the introduction of such mechanisms [10]. Economic valuation in this sense relates to the demand side, i.e. preferences of society as a whole. For the supply side (forest enterprises), cost values count. As soon as both kinds of information are available, it is possible to establish «efficient» incentives for enterprises (forest owners).

According to Binner et al. (2017) the concept of economic value is based on the idea that value (or utility) is a human construct and that it provides a measure by which we might gauge what is the best for a human society. It is compatible with the idea that value may come from non-human entities, but only insomuch as they increase the well-being experienced by humans either by supporting our livelihoods, enhancing our existence or because of a sense of moral duty. Binnner et al. (2017) state, that the value flow from a FES is determined by at least two things:

- the FES's attributes, as determined by the environmental production function through which it is delivered,
- the context within which the FES are consumed, as determined by the other FES, FES and qualifiers that enter the human production function through which the FES delivers value.

Also the issue of aggregation has to be addressed in determining the economic value of a FES, because we need to add together the value flows accruing to all the individuals who gain benefit from that FES [2].

Many frameworks are discussed to assign a monetary value to the benefits of forests ecosystems. A concept which is important in this context is that of the Total Economic Value (TEV). It has been developed in order to consider values, including non-use values, systematically and comprehensively. The study on the TEV of Mediterranean Forest [21] is considered the first attempt at the comprehensive and systematic evaluation of FES in Europe (Mediterranean countries). This study filled a knowledge gap regarding the valuation of nonwood forest products (NWFPs) and provided a first estimate to the TEV including both NWFPs and wood forest products into a common framework.

The TEV approach is based on the different benefits that humans may obtain from forest ecosystems. The main aim of TEV classification, used in Pearce and Moran (1994) and Merlo et al. (2005), was to assess the overall contribution of forest ecosystems to «social and economic well-being.»

This framework typically disaggregates TEV into two categories: use values and non-use values [25]. Traditionally the distinction between use and non-use values has been characterised as the difference between a value that is derived from physical interaction with a FES (use value) and one in which value is derived without physical proximity to or interaction with a FES (non-use values) [2].

Use value refers to the value of ES that are used by humans for consumption or production purposes. It includes tangible and intangible services of ecosystems that are either currently used directly or indirectly, or that have a potential to provide future use values. The TEV separates use values as follows [8], [2]:

- direct use values are derived from FES that are used directly by humans. They include the value of consumptive and non-consumptive uses and they are typically enjoyed by people located in or visiting the ecosystem itself. In other words, an environmental good or service generates direct value if it enters a human production function as a FES.
- indirect use values are derived from a wide range of FES that provide benefits outside the ecosystem itself. That means an environmental good or service generates indirect value if it contributes, through some biophysical process in an environmental production function, to the supply of some other FES.
- the notion of option value introduced Weisbrod (1964). Option values are derived from preserving the option to use in the future services that may not be used at present [16], either by oneself (option value) or by others or heirs (bequest value). Quasioption value is a related kind of value – it refers to the value of information secured by delaying a decision, where outcomes are uncertain and where there is opportunity to learn by delay. This is to say that the information on value will only be revealed over time, mainly because there is uncertainty about the future value of a natural resource [1].

As Binner et al. (2017) state, the distinction between direct and indirect values is important because it informs us as to when we can value an environmental good or service directly (as a FES) as compared to when we first have to understand the science of the biophysical process by which it contributes (as an intermediate environmental goods and services) to the production of FES.

Non-use values from ecosystems are those values that do not involve direct or indirect uses of ecosystem service in question. Humans ascribe value to knowing that a resource exists, even if they never use that resource directly. They reflect satisfaction that individuals derive from the knowledge that ES are maintained and that other people have or will have access to them [15]. In the first case, non-use values are usually referred to as existence values, while in the latter they are associated with altruist or bequest values. These kinds of values are the hardest and the most controversial to estimate. Non-use values involve greater challenges for valuation because they can be related to moral, religious or aesthetic properties, for which markets usually do not exist. This is different from other services, which are associated with the production and valuation of tangible things or conditions. Cultural services and non-use values in general involve the production of experiences that occur in the value's mind. These services are therefore co-produced by ecosystems and people in a deeper sense than other services [4].

However, Binner et al. (2017) pointed out, that the various categorisations (such as that under TEV) are just categories and that to a certain extent those attempts at categorisation are superseded by the ecosystem services approach's focus on environmental goods and services as arguments in human production functions. In short, an environmental good or service generates as many different values as there are human production functions to which it contributes.

Overview of valuation approaches and methods

In the last decades, valuation methods (VM) have reached a considerable degree of sophistication. The last decades have also witnessed a gradually emerging consensus on the state-of-the-art of the range of valuation methods at hand, which is reflected by the fact that recent handbooks and manuals on the topic provide very similar overviews and assessments of the individual tools, with differences remaining essentially on the level of terminology and classifications [24], [6], [10], [27].

The existing scientific literature on valuation of ES is based on two distinct foundations. The ecological valuation methods aim to assess the significance of landscape characteristics. Their common characteristic is the neglect of consumer preferences. The economic valuation methods focus on the exchange value of ES and their common characteristic is that they do not address the complex internal structure of ecosystems. The methods of economic valuation of ES are conventional economic valuation and non-monetizing valuation. A detailed

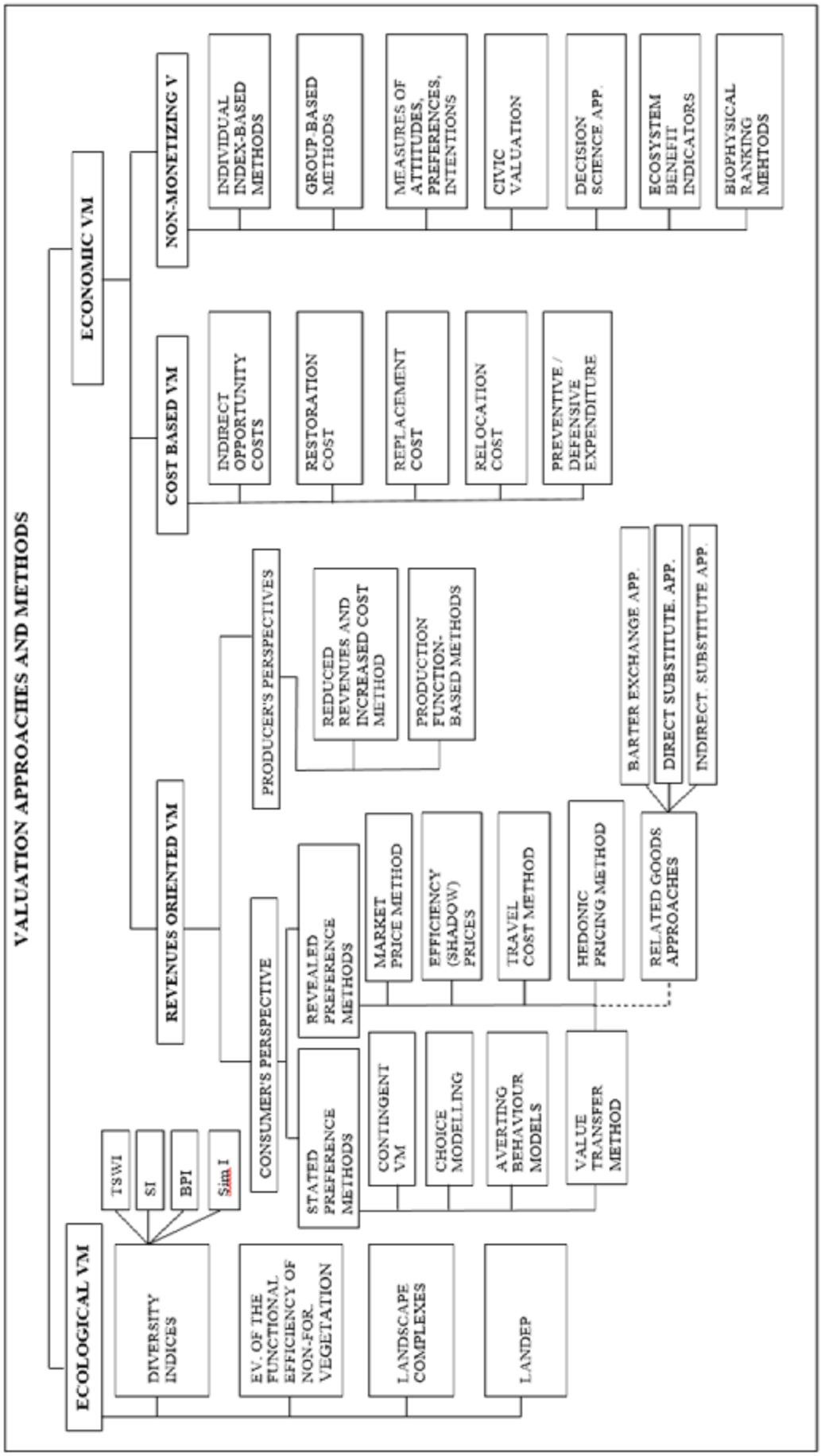

Figure 1 Overview of valuation approaches and methods
TSWI - The Shannon–Wiener Diversity Index; SI - Simpson's Index; BPI - Berger–Parker Diversity Index; Sim I - Similarity indices
VM – valuation method; APP. – approach; EV. – evaluation

historical overview can be found in various papers, e.g. Gómez-Baggethun et al. (2010) or Liu et al. (2010).

There is also another way to classify economic valuation methods. A spectrum of non-market valuation techniques has been developed to value ES. The use of a monetary metric assumes that individuals are willing to trade the ecosystem service being valued for other services represented by the metric. The basic distinction among monetary valuation methods is based on the data source, that is, whether it derives from observations of human behaviour in the real world («revealed preferences») or from human responses to hypothetical questions («stated preferences») [17].

Economic valuation attempts to elicit individual preferences within the general public for changes in the state of the environment in monetary terms. These are based on the fundamental principles of welfare economics; whereby the changes in the well-being of individuals are reflected in their willingness to pay or willingness to accept compensation for changes in their level of use of a particular service or bundle of services [14]. The main types of economic valuation methods available for estimating public preferences for changes in ES are [7]:

- Revealed preference (RP) methods are based on actual observed behaviour data, including some techniques that deduce values indirectly from behaviour in surrogate markets, which are assumed to have a direct relationship with the ecosystem service of interest,
- Stated preference (SP) methods use carefully structured questionnaires to elicit individuals' preferences for a given change in a natural resource or environmental attribute. SP are based on hypothetical rather than actual data on behaviour; for the former the value is inferred from people's responses to questions describing hypothetical markets or situations (Figure 1).

Suggested output of the analysis

Each FES and valuation purpose requires a specific or more suitable valuation method, and every forest ecosystem service valuation is only valid for a specific area and period i.e. must be spatially and temporally explicit. Therefore, the output of the analysis of different approaches and methodologies on FES valuation is to design an interactive table. The table should document the suitability of valuation methods for individual FES (considering benefits and limitations of each method) in a clear, concise and comprehensive way. The table should provide simple orientation within different valuation methods. It should also relatively quickly and clearly propose suitable method, which could be used to value individual FES in a given situation.

It also should show simple references to the explanatory notes (description of the method, its benefits and limitations as well as practical example of its use) where, if necessary, the user will find detailed information.

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