ALPINE ECOSYSTEM SERVICE CONCEPT

STEFAN MARZELLI, MATTHIAS RIEDEL, GÜNDEN SAVAŞÇI, CONSTANZE NEUMANN, LINDA SZÜCS

CONTACT DETAILS OF THE AUTHORS:

ifuplan

Dipl.-Ing. Stefan Marzelli
M.Sc. Matthias Riedel
M.A. Günden Savaşçı
M.Sc. Constanze Neumann
Dr. Linda Szücs

ifuplan - Institute for Environmental Planning
and Spatial Development
Amalienstraße 79, 80799 Munich
E-MAIL: mail@ifuplan.de
PHONE NUMBER: +49-89-3074975-0

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AlpES – mapping, maintenance and management

The Alpine Space is an important provider of Ecosystem Services. These Ecosystem Services are one of the main pillars of a Green Economy in the Alps, a key driver of Alpine development and the focus of the last State of the Alps report. The population and different economic sectors such as tourism, forestry, agriculture, energy and transport in- and outside the Alpine Space derive benefits from Ecosystem Services. However, sectoral conflicts are becoming increasingly complex. AlpES builds on and provides testing and implementation opportunities for the Ecosystem Services concept, which is already established at EU level and can help in resolving conflicts among different interests, particularly in transnational contexts.

AlpES lasts from December 2015 to December 2018 and is co-financed by the European Regional Development Fund through the Interreg Alpine Space programme.

TABLE OF CONTENT

PREFACE

Why caring for Alpine ecosystem services? The Alpine area consists of many different ecosystems and land use systems. They stand at the origin of manifold services and unique cultural landscapes rooted in these ecosystems as well traditions based on them and finally they provide the basis of well-being for millions of inhabitants and visitors in the Alps.

The Alpine area supplies ecosystem services not only for the Alpine area itself but also for far distant surrounding regions in Europe. These regions participate in ecosystem services in the Alps such as supply with water runoff, provision of high quality drinking water, accessible landscapes with high recreation value, provision of timber and many more.

The identification, assessment and mapping of ecosystem services in the Alps are the basis for their valuation – and, indeed their appreciation – which in turn are the precondition for their sustainable management and maintenance. This valuation can be a starting point for a better balancing of the provision and use of ecosystem services within the Alpine Convention area as well as between the Alpine Convention area and its surrounding regions. Furthermore the awareness and valuation of ecosystem services can launch a re-thinking of our relation to nature and nature-based solutions as a new or newly discovered basis for our economic activities. Thus the implementation of the ecosystem services concept contributes to national, international and European efforts towards greening the economy.

The AlpES project has contributed to such a step forward in the Alpine area in defining a framework for a common understanding of ecosystem services, demonstrating suitable indicators and the options for mapping ecosystem services and finally in presenting the results to a broader public via WikiAlps, the WebGIS and the learning tool. I do hope that we – collectively and individually – will make the best use of these important contributions.

Ambassador Markus Reiterer
Secretary General Alpine Convention

INTRODUCTION

Figure 1: Alpine pastures provide the basis for livestock farming

The AlpES project

What relevance do ecosystem services have in a modern world? What does this mean for the Alpine area? Ecosystem services are based on understanding nature as the most important provider of goods and services to human beings – even in a modern, industrialised world.

These are the starting points for the multi-annual working programme of the Alpine Convention and are reflected in the Alpine Space programme. Therefore the agenda of the AlpES project includes the analysis and development of and understanding of the ecosystem service concept in the different Alpine countries. It focuses on the mapping, maintenance and management of ecosystem services. Hence, the project gathers comparable information on the status of ecosystem services in the Alpine area and searches for tools that can integrate them in decision-making processes and in territorial development. From a more general standpoint, ecosystem services may become a tool for a regional and transnational environmental governance framework. Consequently, the project trains and supports target groups such as public authorities, interest groups, enterprises, NGOs and the general public, to understand better, value and manage ecosystem services.

The overall objective of the AlpES project is to introduce ecosystem services as a regional and transnational environmental governance framework and empower stakeholders in understanding, valuing and managing ecosystem services in the areas for which they are responsible, while also factoring in specific local and geographical settings.

Common understanding

The objective of this booklet is to develop and foster a common understanding of ecosystem services for decision-makers, public administrations and the public at large. It introduces the concept, its opportunities, challenges and obstacles/bottlenecks, and also provides insights into what we know about ecosystem services in the Alpine area. Furthermore, it outlines how it can be implemented in day-to-day business activities. These outputs are based on work package 1 of the project, and they can also be transferred to other regional situations. This booklet is equally conceived as a basis for other outputs of the AlpES project, such as the short "Ecosystem Services in the Alps" report, WIKIAlps and a WebGIS on ecosystem service provision.

A deeper insight into the ecosystem service concept in the Alpine area is provided in the short "Framework for Alpine ES, main ecosystems and possible indicators" report, which is intended for scientific and planning experts.

In a nutshell, work package 1 of the AlpES project has gathered and compared different understandings of ecosystem services and of ecosystem service mapping and also about the potential of different instruments to consider ecosystem services in planning and decision making.

Environmental policy and the ecosystem service concept

The ecosystem service concept is not merely a scientific concept to better understand ecosystems and their interaction with human beings. The concept might hold an even greater potential in developing a holistic decision support system and could also provide a cornerstone for new and sustainable interaction between humans and nature.

> "Ecosystem services need to become part of the "thinking framework" of stakeholders, which requires commons standards and methodologies cutting across sectors." Pavan Sukhdev, The Economics of Ecosystems and Biodiversity (TEEB), UNEP [1]

Figure 2: By agreeing on the Sustainable Development Goals (SDGs), policy has defined targets for improving human well-being. Many of these targets build on the contributions of ecosystem services to human well-being .

The implementation of the ecosystem service concept is in line with international Nature Conservation policies, the EU Biodiversity Strategy and more in general with the objectives of many national biodiversity strategies in the Alpine area (cf. „Policy background“, p. 40).

Acknowledging the goods and services of nature as the basis for our economy and our well-being, offers a different viewpoint on why, how and where we maintain these services: it is not merely because nature needs to be protected, it is also because we want to safeguard quality of life for ourselves and future generations. This is likewise connected and interrelated strongly with nature itself. Consideration of the opportunities and limitations of ecosystem services is a matter of environmental justice and responsibility.

Hence, this approach to considering nature also becomes a governance issue – we have to negotiate the best solution – the best nature-friendly and nature-based solution.

Even though the project has not explored the economic values of ecosystem services in any depth, the ideas expressed above also drive us to re-think our financial system: ecosystem services are the basis of our economy – and because of that we have to take them into account also economically. As a first step we need to recognise the economic dimension of ecosystem services in terms of the input to our economy by material (e.g. water, food, raw materials), in terms of the avoidance of higher costs (e.g. those required by natural hazard controls, filtering and purifying processes) and lastly in terms of innovation (e.g. bionic and biochemical functions), creativity (e.g. art and spiritual inspiration) and their contribution to personal well-being (e.g. experiencing nature, physical exercise).

This entails calculating these values, which are frequently considered as external costs, and integrating them into our pricing system in the long term. If doing so, our economic system and our behaviour will most probably change. However, this is a topic that has only been explored within the limited scope of the project but could become an important focus for future research.

1 / (p. 5):
„The Economics of Ecosystems and Biodiversity“ (TEEB), Pavan Sukhdev
https://www.sustainabilityprofessionals.org/summary-reporting-about-rio20-2012-conference-issp

Figure1:
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Figure 2:
UN 2018: https://www.sustainabilityprofessionals.org/summary-reporting-about-rio20-2012-conference-issp

ECOSYSTEM SERVICES IN THE ALPINE AREA

A Framework for understanding ecosystem services

What are ecosystem services in the Alpine area?
Even though slightly diverging definitions of ecosystem services are used in the scientific field and in different contexts, one can generally say that:

"Ecosystem services are the benefits people obtain from ecosystems".[2]

This is a definition that is followed by most of the Alpine countries at a national level. Ecosystem services exist in all regional or national contexts and any attempt to delineate clear boundaries of ecosystem services that only exist in one area will be challenging. We understand the Alpine area as the Alpine Convention area and the Alpine Space area. When compared to the general perception of ecosystem services in Europe the term "Alpine ecosystem service" emphasises services that may have particular relevance in the Alpine area. Chapter „Selecting Alpine Ecosystem Services" (p. 13)explains how to define a selection of Alpine ecosystem services.

How are ecosystem services related to human well-being?

Provisioning Services are often goods obtained from ecosystems such as timber for energy or construction.

Figure 3: Example for Provisioning Services: Timber

Regulating Services are benefits derived from functions such as protection of areas against rockfalls.

Figure 4: Example for Regulating Services: Protection against rockfalls

Cultural services are mostly non-material benefits such as nature and aesthetic experiences.

Figure 5: Example for Cultural Services

Classification of ecosystem services

Ecosystem services can be grouped into three or four main sections as illustrated in Figure 6:

* Provisioning Services are often goods obtained from ecosystems such as food, fresh drinking water, raw materials for energy or construction.

* Regulating Services are benefits derived from functions such as climate regulation, water regulation or disease regulation; pollination is also included in these functions.

* Cultural services are mostly non-material benefits such as recreation, health support, nature and aesthetic experiences, inspiration, etc.

* Supporting services are underlying services that are needed for other ecosystem services. Soil formation, nutrient cycles, photosynthesis or biodiversity belong to this group. As these services are often indirectly part of the first three services, supporting services usually are not tackled as such.

Frequently the “supporting services” section is not considered as a separate section but is merged with “regulating services”.

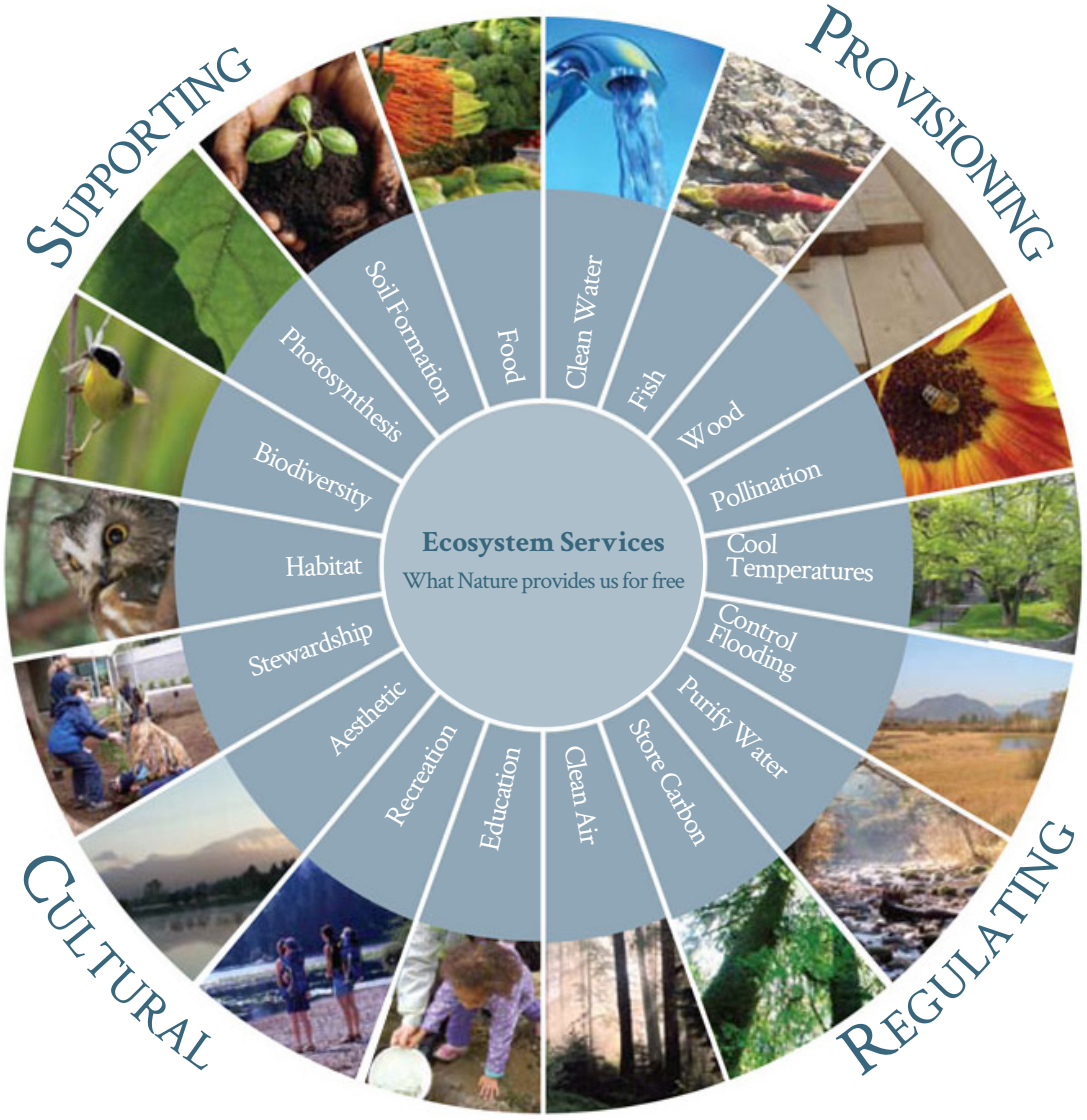


Figure 6: Sections of ecosystem services

To achieve a comparable system of ecosystem services, a common classification system, known as CICES , has evolved in Europe. This classification system provides a structure with five different levels of ecosystem services types. It is also a basis for the systematic gathering of ecosystem services into a national accounting system that should lead to integrating ecosystem services into green accounting.

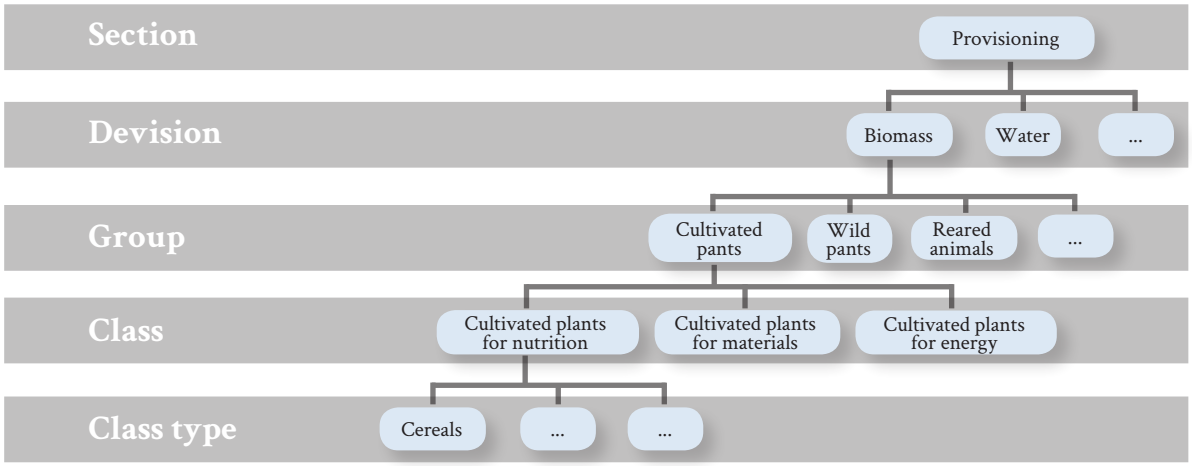


Figure 7: Classification structure of ecosystem services within CICES

Linkages between ES and human well-being

The Millennium Ecosystem Assessment has analysed the global status of ecosystems, the interactions between nature and humans, and potential developments. This is the first study to have emphasised the relevance of ecosystems for human well-beings. In this instance, the ecosystem service concept is seen from an innovative perspective: it no longer considers ecosystems and the environment as something external to human activities but as the foundation of our well-being. Hence, careful management of ecosystems is an essential precondition for our well-being.

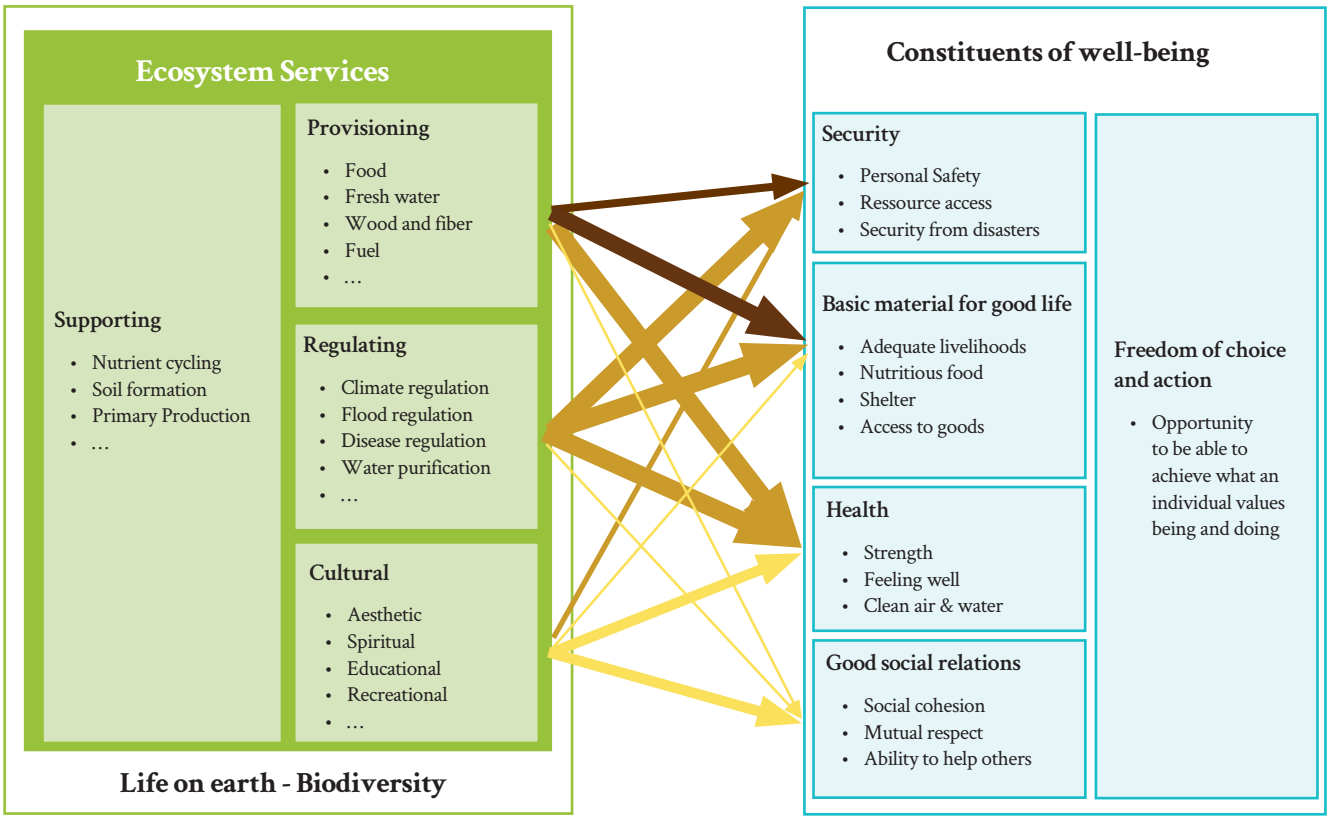


Figure 8: Interactions of ecosystem services and human well-being

Figure 8 explained: The darker the arrow, the higher the influence of socioeconomic factors for potential mediation; the thicker the arrow, the stronger the link between ES and human well-being.

Figure 9

Public awareness

Opportunities to promote sustainable development and use the ecosystem service concept also rely on public awareness and general knowledge. Conversely, ecosystem services may promote a better understanding of interlinkages between ecosystems and our economic and social systems. However, existing environmental management or territorial development instruments also presume a certain amount of public knowledge and willingness to participate and be part of the processes that such instruments require.

The Eurobarometer Study[3] analyses the attitude of European citizens towards biodiversity. Even though the term "ecosystem service" is relatively unrecognised and little is known about it, one of the Study outcomes shows that a vast majority of Europeans agree that health and well-being depend upon nature and biodiversity. Several studies on levels of awareness of nature, ecosystems and biodiversity also exist nationally, and they prove that there is a general awareness of linkages between nature and human well-being. However, this general awareness is not yet linked to behavioural changes regarding lifestyle changes or consumer attitudes. There are promising initiatives of NGOs such as CIPRA, Alpine clubs and others that stimulate contributions to bring about governance changes. The ecosystem service concept has not been used so far and is only rarely mentioned in this context.

Any implementation of the ecosystem service concept will also have to consider social preconditions in

relevant areas. Social factors such as population density, age distribution, labour market, level of education, cultural background, income distribution, and many other factors, influence the way people recognise, value and treat ecosystems and biodiversity. All these elements form the framework for the development of a governance process (cf. chapter: „How to consider ES in decision-making?“).

Selecting Alpine Ecosystem Services

For the practical implementation of ecosystem services in a distinct area it is necessary to achieve a clear definition and selection of the ecosystem services that are relevant to this area. This step is required before undertaking a physical assessment of ecosystem services using indicators and data.
A definitive selection of “Alpine ecosystem services” or ecosystem services for the Alpine area does not exist. Moreover, it is almost impossible to claim that certain ecosystem services are only present in the Alpine area. Some services, such as the regulation of specific natural hazards, are only relevant in Alpine areas, e.g. avalanches, mudslides and rockfalls. But these too may occur in other steep mountain ranges and not just in the Alps. In examining the commonly defined list of potential ecosystem services in the European classification system, the AlpES project has identified ecosystem services of particular alpine relevance. Due to time and budget constraints we have selected eight of these services from the CICES list to represent each of the ecosystem services divisions to be tackled by the AlpES project. The selection also considered specific criteria such as geographic relevance, the influence of local and regional policies, good tangibility, availability and assumption of basic data.

Table 1 List of selected ecosystem services having Alpine relevance

Nr.	Ecosystem service
1	Drinking water with minor or no treatment
2	Grassland biomass
3	Fuelwood
4	Filtration of surface water by ecosystems
5	Protection of areas against avalanches, mudslides and rockfalls
6	CO2 sequestration by forests and bogs
7	Outdoor recreational activities
8	Symbolic alpine plants, animals and landscapes

Where can these ecosystem services be found in the Alpine landscape?

Examples of ecosystem services are indicated in Figure 10 such as

* Mountain forests that provide services for air pollution by filtering air, by contributing to erosion control and climate regulation.
* Landscape amenities support recreation and tourism and provide health benefits for citizens.
* Grassland biomass produces food that is used by cattle.
* Bogs and floodplain forests in the Alpine area contribute to flood control and water quality regulation.
* Alpine surroundings may also be a setting that fosters cultural and spiritual values
* Mountain forests produce timber, they contribute to soil quality regulation and offer habitat for plant and animal species.

Figure 10: Examples of ecosystem services in an Alpine landscape, Etschtal


Air pollution control
Erosion control
Climate regulation
Aesthetic values &
sense of place
Recreation & tourism
Health benefits
Cultural &
spiritual values
Food
Water quality regulation
Flood regulation
Timber
Soil quality regulation
Species diversity

Some examples of ecosystem services selected as having particular relevance for the Alpine area are listed below:

Figure 11

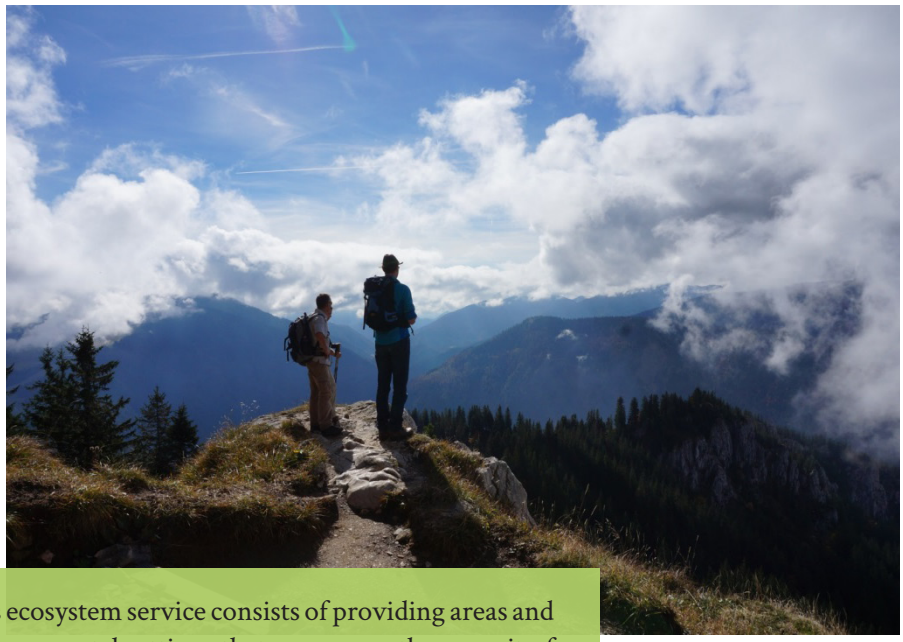
The ecosystem service, in this case, is the quantitative provision and renewal of surface and / or groundwater.

Drinking water with minor or no treatments

The provision of drinking water is a crucial contribution of ecosystems for regulating the quantitative provision, the spatial and temporal distribution and the quality of drinking water. Water, which is abstracted from surface waters, springs and groundwater aquifers, is a major service with respect to the provision of drinking water for the Alpine population as well for millions of people outside the Alpine area. Water sources (surface water, springs or groundwater) may differ across the Alpine regions.

Figure 12

This ecosystem service counteracts the occurrence of avalanches, mudslides and rockfalls by natural vegetation, especially forests (e.g. mountain forests), shrublands and grasslands.



This ecosystem service consists of providing areas and environmental settings that encourage the pursuit of outdoor activities.

Figure 13

Outdoor recreational activities

Outdoor recreational activities in the Alpine area are carried out in beautiful natural and semi-natural landscapes. The Alpine area is one of the most famous recreational and touristic destinations in Europe. This makes it a well-known and highly appreciated destination for the Alpine population as well for millions of tourists from outside the Alps. Tourism and recreational activities are also an important economic sector.

Protection against avalanches, mudslides and rockfalls

Avalanches, mudslides and rockfalls are phenomena of mountain ranges, which can result in loss of life and property. Natural protection against these hazards is, therefore, a highly relevant ecosystem service for the Alpine population. It also affects people outside the Alps if transport corridors or agricultural and commercial areas are endangered.

2 / p. 8:
“Ecosystem services are the benefits people obtain from ecosystems”. http://pdf.wri.org/ecosystems_human_wellbeing.pdf

3 / p. 12:
The Eurobarometer Study: European Commission (2015): Attitudes of Europeans towards biodiversity. Brussels (Special Eurobarometer, 436)

Figure 3,4,5,9,10,11,12,13 :
ifuplan

Figure 6:
Sections of ecosystem services
http://www.metrovancouver.org/services/regional-planning/PublishingImages/EcosystemServices.jpg

Figure 7:
Classification structure of ecosystem services within CICES
Common International Classification of Ecosystem Services
https://cices.eu/cices-structure/

Figure 8:
Interactions of ecosystem services and human well-being
MEA 2005

Table 1:
List of selected ecosystem services having Alpine relevance; altered after CICES V. 4.3, https://cices.eu/cices-structure/

MAPPING AND ASSESSING ECOSYSTEM SERVICES

What are mapping and assessment?

The terms mapping and assessment are often used in a fixed combination when talking about ecosystem services. They do, however, reflect different aspects of an integrated process.
In this context "Assessment" generally means the assembly, analysis and interpretation of data related to ecosystem services, with the intention of providing general information that can best be used in supporting decision-making processes.

"Mapping" can have different connotations: "Ecosystem mapping" refers to a delineation of ecosystems that can provide ecosystem services; "ecosystem service mapping" [4] refers to a cartographic representation of (quantified) ecosystem service indicators in geographic space and time. Lastly, in a social context, ecosystem service mapping may also be understood as the representation of people's perception of ecosystem services .

Mapping and assessment exercises are labour intensive tasks; objectives should, therefore, be well clarified before starting such exercises. What questions require answers or which management decisions need to be supported?

For instance, if the development of tourism in the Alpine area is on the agenda, affected ecosystem services could be addressed such as food and timber provision, natural hazard prevention, and the use of drinking water but also most suitable areas for tourist attraction. Relevant conflicting objectives ("trade-offs") need to be identified together with potential compensation in the event of decreased ecosystem services. ES assessments and maps can cover various sectoral and intersectoral decisions; choosing the appropriate framework influences both conceptual and methodological aspects.

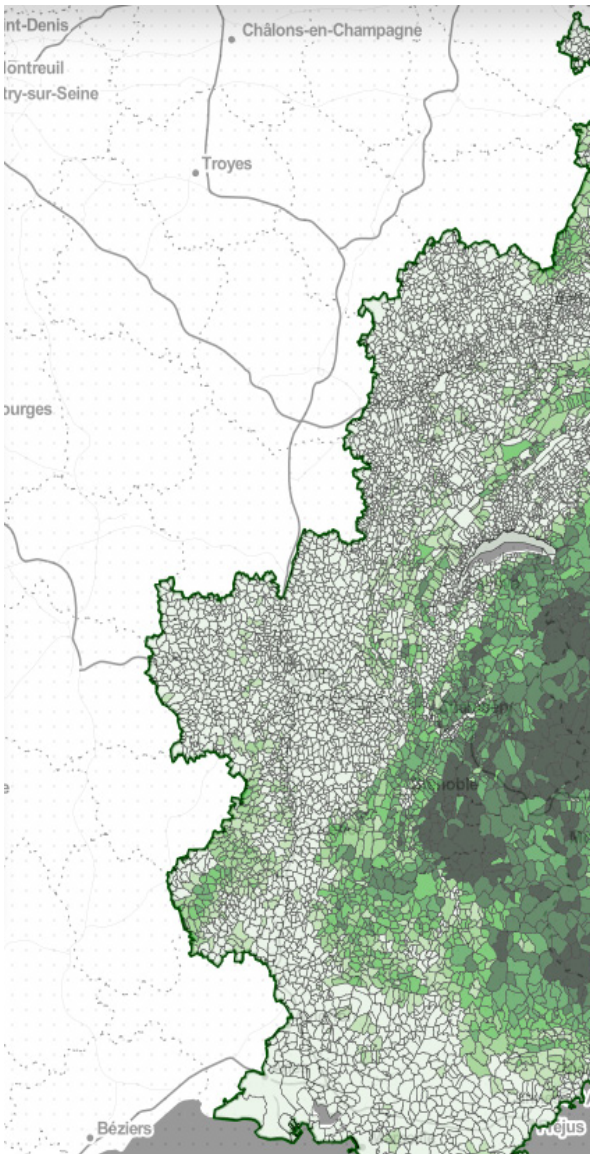
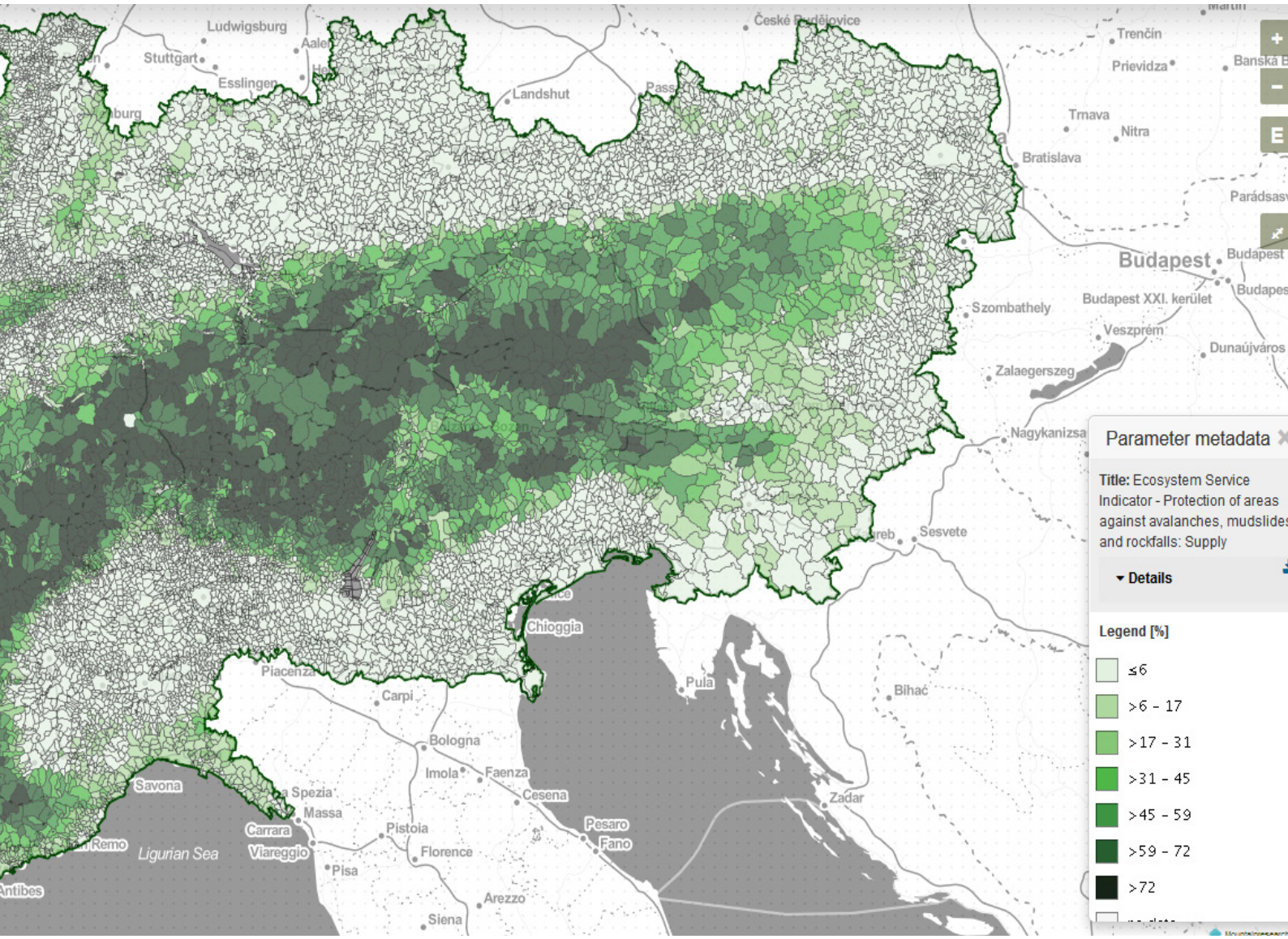


Figure 11: AlpES WebGIS Map of the Protection of areas against avalanches, mudslides and rockfalls: Protection provided by forests

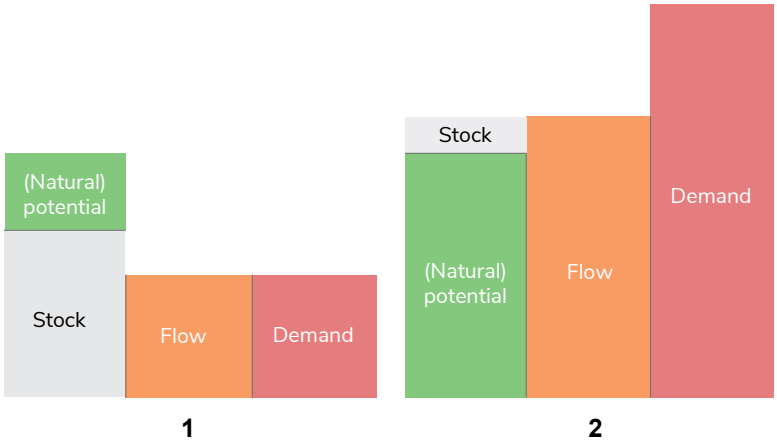

Ludwigsburg
Stuttgart
Esslingen
Landshut
České Budějovice
Trenčín
Prievidza
Trnava
Nitra
Bratislava
Budapest
Budapest XXI. kerület
Szombathely
Veszprém
Zalaegerszeg
Nagykanizsa
Dunaújváros
Sesvete
Chioggia
Piacenza
Carpi
Bologna
Imola
Faenza
Cesena
Pesaro
Fano
Pula
Bihać
Zadar
Savona
Spezia
Massa
Carrara
Viareggio
Pistoia
Florence
Pisa
Arezzo
Siena
Ligurian Sea
Parameter metadata
Title: Ecosystem Service Indicator - Protection of areas against avalanches, mudslides and rockfalls: Supply
Details
Legend [%]
≤6
>6 - 17
>17 - 31
>31 - 45
>45 - 59
>59 - 72
>72

How to assess ecosystem services

Supply, flow and demand of ecosystem services

When assessing ecosystem services an important distinction is to specify which kind of ecosystem service interaction is described. Supply, flow and demand are commonly the main differentiations used to group ES interactions (cf. Figure 12):

Figure 12: Scheme of supply, flow and demand: Case 1 describes a situation where demand can be covered by the flow of ES within the limits of the natural stock. Case 2 represents the situation in which demand cannot be satisfied by the flow, even if the natural potential is overexploited. This means that demand needs to be covered by other sources.



* Supply describes the provision of ecosystem services by an ecosystem itself. It can be divided into potential supply (also referred to as capacity), which is the natural contribution to the generation of ES (for example wild berries in a forest) and status supply. Human inputs that increase or decrease the supply are not incorporated in potential supply. Status supply describes the real provision of an ecosystem service based on the actual use of the providing ecosystem (for example provision of berries from berry farming). Here human inputs are included.

* Flow describes the ecosystem services or bundles of them within a specific area in which they are actually used over a given period (for example berries harvested from berry farming).

* Demand describes the demand for an ecosystem service: its goods and benefits by society, individuals and stakeholder groups, that are currently exploited, consumed or used in a particular area (for example local market demand for berries).

More detailed information, definitions as well as demonstrations of the relationship between the ES assessment types can be found in short report “Framework for Alpine ES, main ecosystems and possible indicators”.

Supply of ecosystem services means the provision of benefits such as timber, clean water or recreational landscape in a mountain valley. The flow means the amount of timber, water or landscape which is used and demand represents the amount people are asking for in an area.

Frequent challenges in assessing ecosystem services

Assessing ecosystem services can be quite challenging both methodologically and in practice. However, these challenges can be dealt with, and they are not a serious enough reason to refrain from using the ecosystem service concept.

* Many indicators are available to describe ecosystem services; however appropriate data are often missing, so only rough estimates can be made regarding the real supply, flow and demand of ecosystem services.

* The evaluation of the sustainability of land uses will need to refer to the ecosystem's capacity to provide certain services. It is often quite difficult to define this capacity, as most ecosystems have been shaped by human land uses over time.

* Geographical areas of demand for ecosystem services may be different from those for ecosystem service provision; sometimes they may be even located at a considerable distance. An understanding of how to integrate the use of an out-of-area ecosystem service has not yet been achieved.

* Further methodological challenges are related to the amount of human, technical and capital influence on the ecosystem service provision, to whether abiotic environmental services are considered (such as wind, hydropower, rocks and minerals) and to the role of biodiversity.

Challenges for a broader application of the ecosystem service concept are to find up to date data, suitable for the scale being considered (e.g. mountain municipalities, valleys, or even mountain ranges or the whole Alpine area). Thresholds for the sustainable capacity for the provision of ecosystem services need to be identified (e.g. maximum water abstraction for drinking water or maximum yield of grassland). Additionally, the integration of ecosystem services, which are provided from out-of-area, is required (e.g. water imported from other valleys for irrigation, food imported from other areas). Lastly, it is necessary to distinguish between ecosystem functions and external factors (e.g. inputs from mountain farming, pasturing) that contribute to the ecosystem service provision.

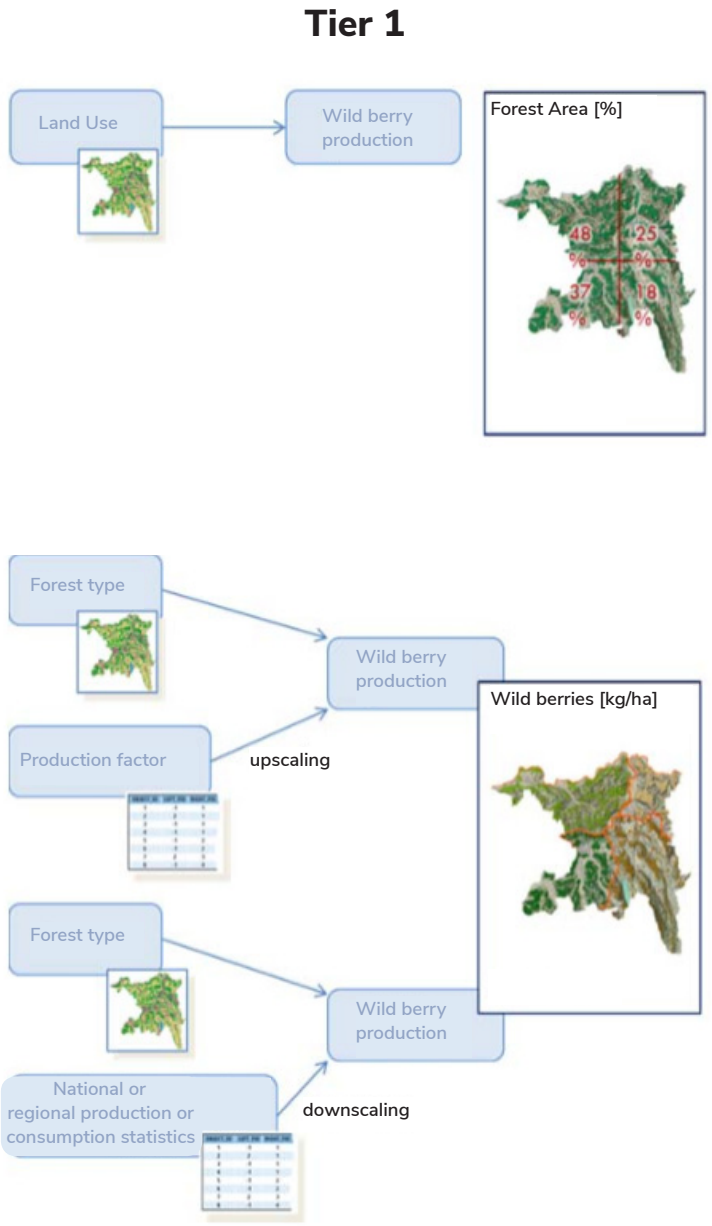
Indication and Quantification

Assessing ecosystem services is possible to different levels

Assessing ecosystem services requires some effort since at times appropriate data are not available. Therefore three hierarchical approaches, with increasing complexity (called "tiers"), are commonly applied to ecosystem service mapping:

* Tier 1 – ES mapping using available indicators: The most basic approach assesses ES by using existing, widely available (large-scale) datasets (such as Satellite data) as a proxy for the provision of reliable ES. Most indicators in this tier adopt land use and land-cover data, biodiversity monitoring maps, national forest inventories, etc. Scores based on expert estimations are also used. For example, selected land cover classes from satellite images can be taken as a proxy for timber production.

* Tier 2 – ES mapping linking different indicators with land use data": Land cover and land use data, as well as specific environmental data from national to local levels, are used to describe supply, flow and demand of ecosystem services. For example, mountain forest density on steep slopes can indicate a natural hazard prevention service.



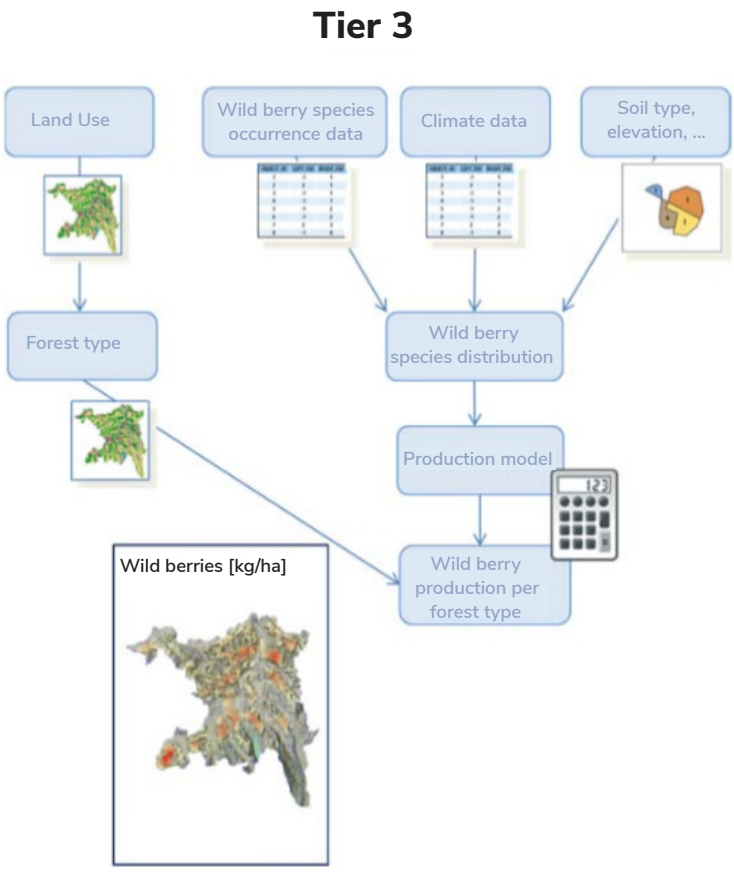


Figure 13: Different tiers for ecosystem services assessment

* Tier 3 – Model-based approaches to map ES: Biophysical processes are modeled using a GIS or other software, instead of linking indicator data through simple relationships or to generate new data regarding issues for which no data exist so far. For example, wild berry production is modeled on the basis of soil, climate and vegetation data. Building such a model is time-consuming and requires expert knowledge in modeling. Additionally, models need to be used with caution: the more factors are included the higher risk of results having a large margin of deviation. Therefore models often need to be calibrated to the local conditions.

The choice of the preferred tier will depend on available data, working resources and requirements for the use of the outcome. Indicator approaches are rarely limited to only one specific tier but rather spread across them and also consider the possibility of combining them.

Biophysical assessment and sociocultural evaluation

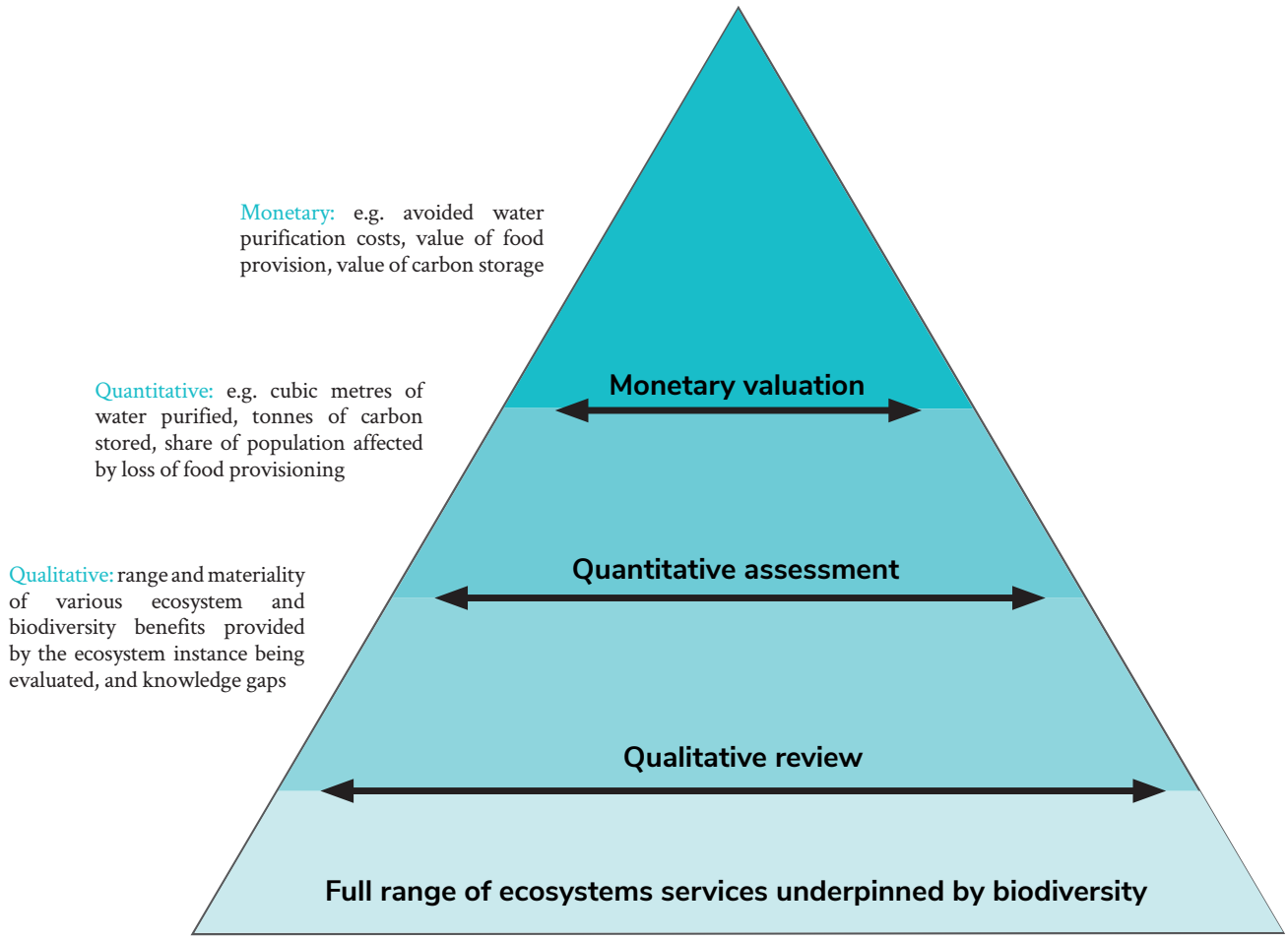
Assessing ecosystem services is the precondition for their management. It is necessary to know where given amounts of ecosystem services are produced and under what supporting or limiting conditions. This assessment may use qualitative estimations but the more precise the data the better.

Besides the biophysical assessment of ecosystem service conditions, evaluation and analysis from a sociocultural perspective also play an important role: hence the value of ecosystem services may be estimated in different ways according to elements such as cultural background, knowledge and socioeconomic status.

Values may be assigned to ecosystem services in different terms such as:

* one's personal appreciation of the existence of an ecosystem service (e.g. fruit that tastes good, clean drinking water, timber suitable for construction),
* quantitative values based on the measurement of the provision (e.g. areas protected by mountain forests, hay harvested from pastures),
* definition of the proportion of services being used (e.g. used timber as percentage of forest increments, extracted water as share of renewed water table)
* Demand, as well as its spatial distribution of ecosystem services, are also relevant items of information (see Figure 15)
* lastly, monetary values can be attributed to physically quantified ecosystem services (cf. also Figure 14).

Figure 14: Scheme explaining the pyramid of qualitative, quantitative and monetary assessment of ecosystem services .


Monetary: e.g. avoided water purification costs, value of food provision, value of carbon storage
Quantitative: e.g. cubic metres of water purified, tonnes of carbon stored, share of population affected by loss of food provisioning
Qualitative: range and materiality of various ecosystem and biodiversity benefits provided by the ecosystem instance being evaluated, and knowledge gaps
Monetary valuation
Quantitative assessment
Qualitative review
Full range of ecosystems services underpinned by biodiversity

Datasets and data acquisition

Data for ecosystem service assessments depend on the geographical level of the assessment. Mapping and assessment often build on existing ecosystem mapping products or other natural and artificial entities. Datasets dedicated to ecosystem services often already exist at a national and European level. At regional or local level such datasets usually need to be processed. Relevant data can be grouped as follows:

* Land use data: these could be based on satellite images, such as available Europe-wide Corine Land Cover or Copernicus data, national topographic and air image data, modelled land cover data, such as the Central European Habitat Map, or even regional territorial mapping data

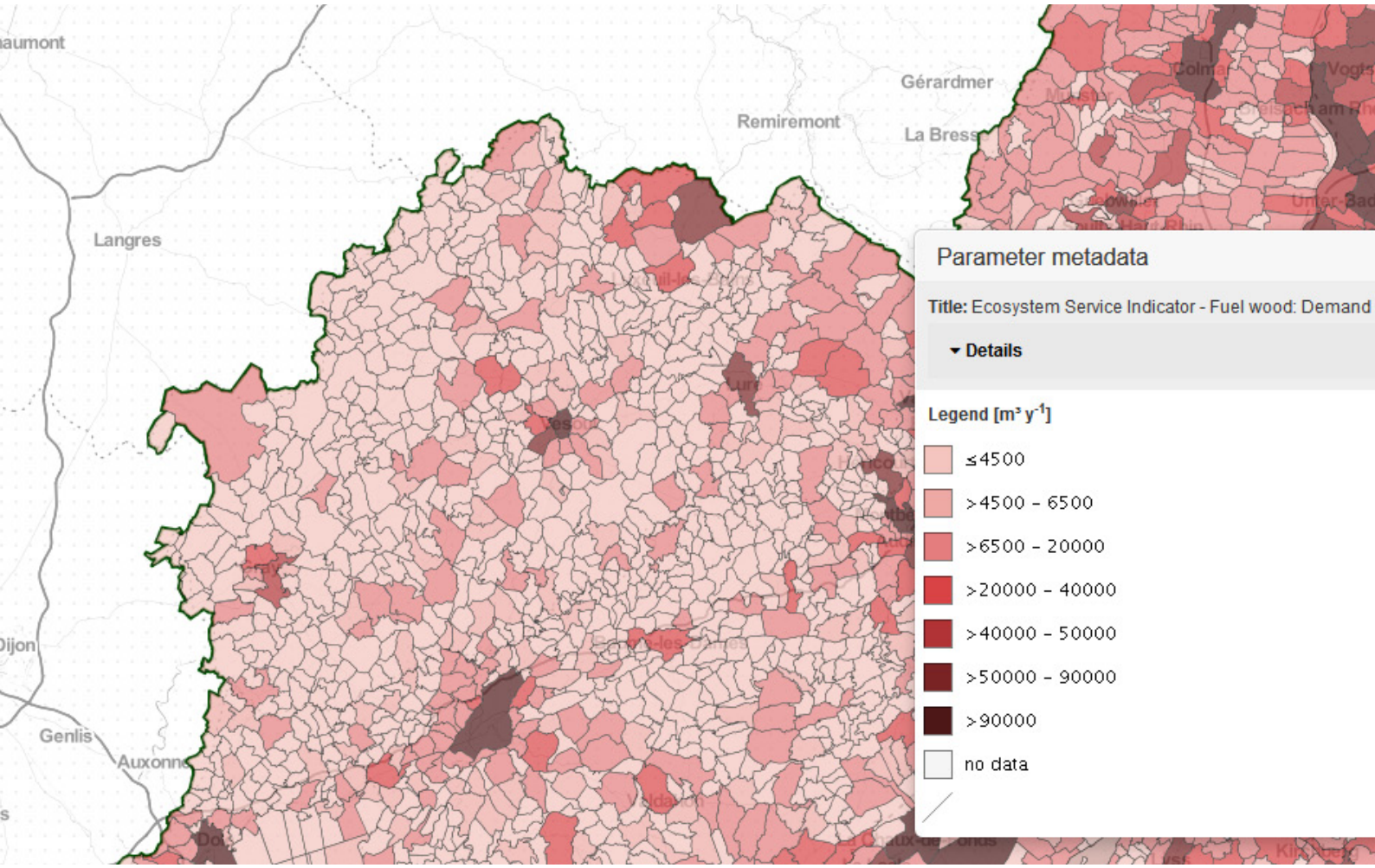
* Specialised data sets: these may offer information on climate, vegetation, soil, water bodies and elevation models

* Community-sourced data: this may be geographical data, such as topographic data, OpenStreetMap or metadata from other social media platforms such as Flickr, Instagram, etc. Accessibility and usage rights are the main issues for these types of data.

* Statistical data sets: they usually correspond to the underlying administrative units from which they were assessed. European data also are accessible (EUROSTAT), together with national data that generally consist of governmental statistical datasets.

An overview of national and international available datasets, with information on habitat typologies, timeframes and resolutions, can be found in the short report deliverable "Framework for Alpine ES, main ecosystems and possible indicators".

Figure 15: Map of the ecosystem service „Fuel wood - demand" displaying provision as m³ per year per municipality


Gérardmer
Remiremont
La Bress
Langres
Genlis
Auxonne
Parameter metadata
Title: Ecosystem Service Indicator - Fuel wood: Demand
Details
Legend [m³ y⁻¹]
≤4500
>4500 - 6500
>6500 - 20000
>20000 - 40000
>40000 - 50000
>50000 - 90000
>90000
no data

Technical limitations of the concept

In the scientific discussion, a theoretical and practical approach for integrated mapping and assessment is suggested. This integrated assessment will not merely translate scientific evidence into knowledge that is relevant for decision-making, its objective is also to link data related to biophysical and socioeconomic components and to integrate contexts related to societal issues. Once again, the fundamental and overarching topic of an assessment is its objective, the question or theme that requires a reaction.
Mapping and assessing ecosystem services have different strengths but also limitations.

In general, a cartographic presentation of ecosystem services as maps is a useful tool to transfer relevant information to stakeholders. The main strengths of ecosystem service mapping are:

* to communicate interactions, trade-offs and synergies between ecosystem services at both spatial and temporal scales

* to identify and compare the relationship between the ecosystem's supply, flow and demand or between ecosystems providing services and beneficiaries receiving such services,

* to better understand spatial relationships wherever there are ecosystem service hotspots and coldspots, and to support the selection, planning and management of areas for specific environmental management issues, for conservation and green infrastructures,

* lastly, to initiate discussions about solutions and alternatives.

On the other hand, the application of ecosystem service mapping can also have the following weaknesses:

* Data directly representing ecosystem services are often not available, that is why land cover data are often used as a proxy. Thus ecosystem services related to land cover are overrepresented while other ecosystem services may be neglected in policy decisions,

* Overrepresentation of a single ecosystem service, without considering its interrelation with other functions and ecosystem services, can lead to negative consequences for ecosystem services that are not being considered (e.g. where provisioning food is overrepresented, other effects related to the regulation of groundwater or soil erosion are neglected),

* The supply of ecosystem services has been mapped more frequently than that of their demand. However, to support decision-making what is

Figure 16

relevant is the relationship between supply and demand as it expresses the sustainability of how ecosystem services are used,

* Spatial and temporal scales of ecosystem service maps and those of decision-making might diverge, e.g. in terms of administrative boundaries or when considering seasonal events

* There may be the risk of a very theoretical assessment when one only relies on data without integrating local stakeholders knowledge.

* The complexity of ecological interactions often makes information about ecosystem services uncertain. Therefore, the potential uncertainty of assessments based on mapping ecosystem services should be highlighted.

4 / p. 19:
„Ecosystem mapping“, „Ecosystem service mapping“:
Jacobs, S.; Verheyden, W. & Dendoncker, N. (2017). Why to map? In: Burkhard, B. & Maes, J. (Hg.): Mapping Ecosystem Services. Sofia: Pensoft Publishers, S. 173–177

Figure 11:
AlpES WebGIS Map of the Protection of areas against avalanches, mudslides and rockfalls: Protection provided by forests, http://www.alpes-webgis.eu/

Figure 12:
Scheme of supply, flow and demand: Case 1 describes a situation where demand can be covered by the flow of ES within the limits of the natural stock. Case 2 represents the situation in which demand cannot be satisfied by the flow, even if the natural potential is overexploited. This means that demand needs to be covered by other sources. AlpES

Figure 13:
Different tiers for ecosystem services assessment
European Commission (2014): Technical Report. Mapping and Assessment under Action 5 of the EU Biodiversity Strategy to 2020, p. 69

Figure 14:
Scheme explaining the pyramid of qualitative, quantitative and monetary assessment of ecosystem services .
The economics of ecosystems & biodiversity. An interim report, 2008, p. 33.

Figure 15:
Map of the ecosystem service „Fuel wood - demand“ displaying provision as m³ per year per municipality;
http://www.alpes-webgis.eu/

Figure 16:
ifuplan

MANAGING AND MAINTAINING ECOSYSTEM SERVICES

How to consider ES in decision-making?

Two-way interactions exist between human society and ecosystems (see Figure 17).

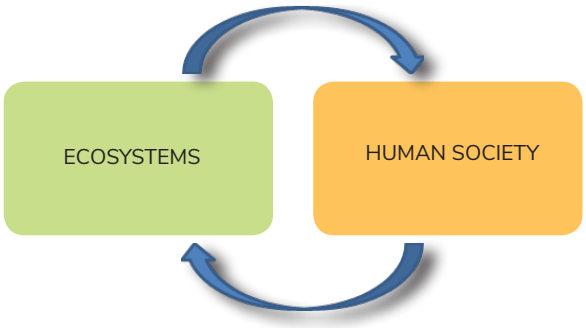


Figure 17: Decisions taken by human society lead to changes in ecosystems and their service provision (e.g. forest clear-cuts and the loss of forest ecosystem services), and the provision of services has effects on human society (e.g. changes in water run-offs for agriculture and economy).

Considering the particular importance of ecosystem service maintenance for human well-being, how can ecosystem services be factored into our decisions? Additionally, what are the main advantages and limitations of the ecosystem service concept for decision-making?

Present, there is no practical concept available about how to consider ecosystem services in decision-making. But they can indeed be used as an informal basis and – from a long-term perspective – they might become part of legally based decision support instruments like environmental impact assessments or spatial planning.
Some of the aspects of the ecosystem service approach that are an advantage for decision-making regarding sustainable development are listed below:

* Ecosystem services explain how we, as humans, depend on and are affected by the provision and maintenance of natural goods and functions. It is therefore in our own interest to consider and support ecosystem services for the provision of a good life and our well-being.

* The relationship between the supply and demand of ecosystem services sets clear limits on the extent to which ecosystems can be used and defines how different areas of supply and demand are interlinked.

* The trade-offs between different ecosystem services become obvious: e.g. if we intensify food production in floodplains, we might have less flood regulation. Hence the negotiation process about the effects of our activities on different ecosystem services can be based on such a coherent concept. This could be one of the building blocks for a form of regional environmental governance in which a society's different stakeholders jointly decide on how to achieve sustainable development.

Some of the relevant advantages and limitations are briefly defined by the keywords in Figure 18.

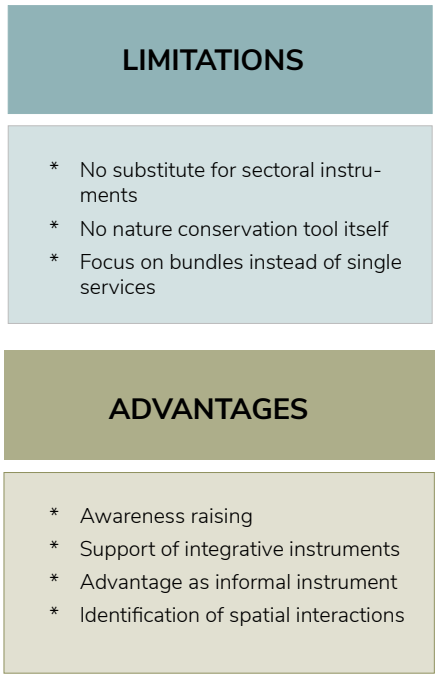


Figure 18: Main advantages and limitations of the ecosystem service concept

Figure 19: Cultural Landscape - reprents the linkages between ecosystem services and human society

* Awareness raising: The ecosystem service concept supports an integrative or holistic view of the use of ecosystems and their services. An understanding of ecosystem service supply makes the dependency of human society visible and creates initial awareness about these nature-based services. Comparing service provision under different development scenarios may help to reveal and explain the trade-offs linked to these scenarios.

* Support of integrative instruments: The ecosystem service concept may be strongly supportive of horizontal management instruments, such as territorial development and land use planning. However, we still lack a clearly structured instrument that uses ecosystem services as a tool: no such instrument has been officially established so far.

* Advantage as an informal instrument: the ecosystem service concept may be very useful as an informal instrument, merging the different requirements of a clearly defined area for decision-makers and the broader public. It can explain what the supply of ecosystem service provision is, what the flow and the demand for ecosystem services are and how they might be affected by different development options.

* Identification of spatial interactions: In its supply-demand-flow analysis, the concept may also discover where ecosystem services are provided, where transboundary effects occur and where demand comes from. Once these linkages are revealed and accepted, areas receiving benefits

Figure 20: Appearance of different ecosystem services in one area . The ecosystem service concept can facilitate the understanding of spatial interactions.

from ecosystem services and those providing ecosystem services may initiate a new approach to cooperation and mutual responsibility.

* Focus on bundles instead of single services: One should always bear in mind, that the ecosystem service concept builds on the simultaneous provision of different services from the same plot of land. Sometimes these are called “ecosystem service bundles”. This means that the objective is never to maximise one ecosystem service only but to develop the best possible combination of ecosystem services provision for one location.

* No substitute for sectoral instruments: Additionally, the ecosystem service concept probably cannot deliver specific sectoral decisions and regulations. Hence it cannot replace existing sectoral instruments; instead it can combine their potential and their effects within an integrative approach.

* Not a nature conservation tool in itself: The ecosystem service concept is actually closely linked to ecosystems and biodiversity but it is not a nature conservation tool itself, nor it is intended replace nature conservation tools (such as protected areas, specific species measures). Of course, the maintenance of ecosystem services will indirectly also maintain natural habitats and relevant species and nature conservation goals. But the ecosystem service concept is instead an instrument for the implementation of sustainable development by delivering a common platform to manage ecosystem outputs.

Economic valuation of ecosystem services

Generally speaking, there is a lively debate about the appropriateness and usefulness of the economic valuation of ecosystem services. Even though economic evaluation has not been one of the objectives of the AlpES project, it seems appropriate to address some of the main key and methodological issues of this debate:

* Fundamentally, it is argued that many values of ecosystem services, particularly in the case of cultural services, cannot or seldom can be assessed using an economic valuation.
  On the other hand, it is equally argued that economic valuation – in an ideal market – is about preferences and choices. We cannot avoid making choices, and we use our personal preferences in taking our day-to-day decisions. We all acquainted with and act upon examples from the non-environmental world. We accept prices as a matter of course for many things that we might consider invaluable, such as art, health and life. Referring again to the environmental debate: we can either ignore the existence and effects of these preferences or we can make them evident by putting an monetary price label on ecosystem services too.
  One can at least make the point that economic valuation raises awareness about the fact that ecosystem services are important economic factors that are often not recognised, and more often are not even taken into account in decision-making.

Figure 21: Golden Eagle

* In methodological terms, a broad array of methods for calculating the economic value of ecosystem services does exist. They may produce a variety of different economic values for the same ecosystem service.

* Moreover, not all economic valuation methods can be applied to all ecosystem services. So bundles of ecosystem services in one spot will be subjected to different economic valuation methods. Lastly, it is important and relevant to clearly delineate the services that provide a given benefit so as to avoid counting the same services twice.

These are the reasons for which economic valuation does not automatically mean facilitating decision-making. Additionally, the economic valuation of ES does not necessarily lead to managing ES more sustainably. It might, however, focus the attention of decision-makers and the public at large to the

Figure 22: Monetary value of nature: 84 % of used plants depend on pollination. The value in Germany is estimated as 2,5 bn. € / year

fact that ecosystems also hold remarkable economic value, which is often externalised from our standard economic calculations. Consequently policy frameworks for the management of ES may play an important role to ensure ES are given a monetary valuation based on sustainable development.

Policy background

Regional Environmental Governance

The term "regional environmental governance" describes a "concept in political ecology and environmental policy that advocates sustainable regional development as the supreme consideration for managing all human activities—political, social and economic ". [5]

Regional environmental governance is a perspective that produces a comprehensive understanding of environmental, social and economic long-term effects and bases decision-making on a fair negotiation process between different interests.
Within the AlpES project, mapping and assessing ecosystem services will contribute to regional environmental governance with the long-term objective of integrating such governance into decision-making processes and instruments.

European and national Policy Background

Starting from the international Aichi-principles adopted by the Convention on Biodiversity, the EU biodiversity strategy clearly addresses ecosystem services. Hence the strategy develops headline target and target 2 with the objective of maintaining and enhancing ecosystems and their services through green infrastructure and of restoring at least 15% of degraded ecosystems by 2020. Additionally, targets 3 a and b consist in the improvement of the provision of ecosystem services within agricultural and forest areas.

"Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss."
EU biodiversity strategy: 2020 Headline target

Several actions are being adopted for the implementation of target 2: inter alia the mapping and assessing of ecosystems and their services in national territories, the assessment of the economic value of these ecosystem services (Action 5), the development of a strategic framework for restoring ecosystems at subnational, national and EU levels (Action 5a) and the proposal of an initiative by 2015 to ensure no net loss of ecosystems and their services occurs (Action 7b).
The EU Green Infrastructure Strategy focuses on improving the maintenance of ecosystem services.
The objectives of the EU Biodiversity Strategy are motivating but also challenging. The present status, however, reveals that so far these objectives have not been met in the EU.
Consequently, also within the European Macro-Regional Strategy for the Alps (EUSALP), the ecosystem service concept is considered a priority topic.
At present no explicit objectives for ES protection or development exist in the Alpine countries at a national level. References to ecosystem services are made mainly at a strategic level, as in the case of national biodiversity strategies (Austria, Germany, Italy). However, there are several early efforts underway to integrate the ecosystem service concept into decision-making processes at a national level (e.g. Italy: new national law).

Transnational relevance

The provision of ecosystem services, but also the adverse effects to which they are subjected, know no borders. Hence, the management and maintenance of ecosystem services also need to be carried out on a transnational basis. This need for transnational cooperation is expressed in the EU biodiversity strategy as well as by several representatives of

the partners/stakeholders/observers of the AlpES project. The basis for such transnational cooperation lies in achieving a common understanding and consequently harmonising assessment and mapping conditions.

Instruments for implementation

Any application of the ecosystem service concept has to consider and be tailored to the most relevant target groups described in Figure 23:

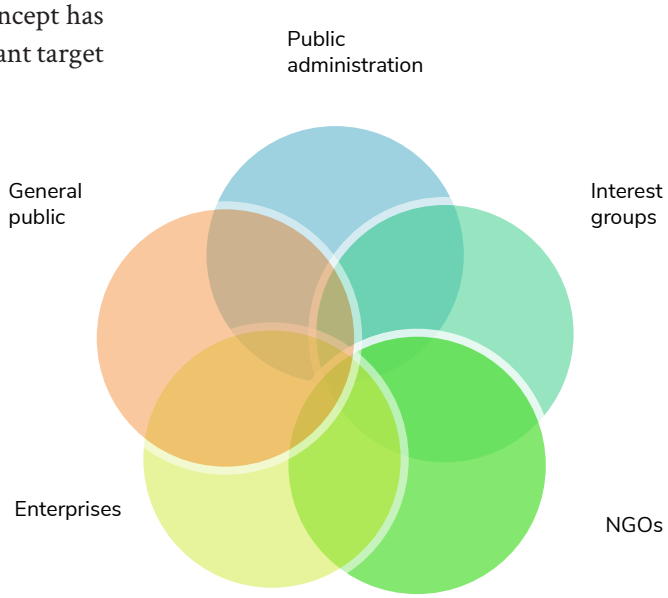


Figure 23: Potential target groups for the implementation of the ecosystem service concept

Identified instruments for implementation
Implementation instruments are either required by legislation or prompted by an economic or societal drive to invent and implement concrete and specific measures. First of all one may differentiate between "informal" and "formal" instruments:

* Informal instruments can be described as processes and procedures without legally binding commitments in a strict sense and with no reference to legal procedures. Examples are roundtable discussions, future labs or citizens' planning groups.
* Formal instruments represent the opposite: Concrete actions and binding results, which are required through legislative decisions, treaties, preconditions and laws. Examples are formal urban plans, environmental impact assessments or nature conservation compensation schemes.

In all Alpine countries, instruments have been collected, grouped together and estimated in terms of their suitability for the implementation of ecosystem services. In the AlpES project, besides the informal and formal categories, instruments have been roughly grouped as follows:

* Laws and Regulations
* (Spatial) Planning
* Financial burdens / costs and incentives
* Voluntary approaches and agreements
* Information and research

In total, almost 150 instruments have been collected and documented in a database. By extracting data from this database, each instrument can be presented using a factsheet that contains key facts in condensed form.

Two examples can provide insights into these kinds of instruments:

* Informal instrument: The Austrian Forest Dialogue ("Walddialog") is a participative policy development process instrument initiated by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management. Considering the future use of forests, the many different stakeholders of governmental institutions, public and private interest groups, as well as any individuals interested in forests, are called upon to develop further the way in which forests are managed. The ecosystem service concept could support this form of dialogue because it addresses multifunctionality.

* Formal instrument: Italian decree n. 6513 regards direct payments to farmers (with particular reference to greening measures for permanent grasslands) and regional laws implementing the Decree. It defines and implements criteria for the identification of areas and farmers that are eligible for greening payments. [6]

The AlpES collection of instruments shows that implementation options for the ecosystem service concept already exist:

* Thanks to their greater flexibility informal instruments generally appear to be more suitable for ES implementation and have a higher transferability potential among the Alpine countries.

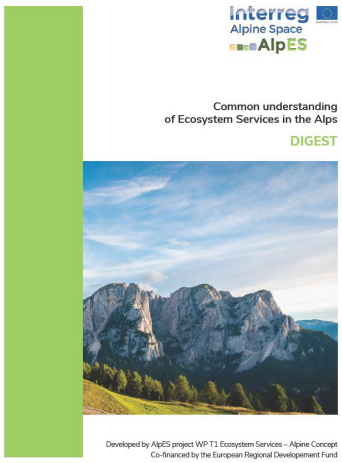
* Transnational implementation requires a sound legal background and concrete guidelines on how to carry out ecosystem service assessments and mappings to provide support for the maintenance of ecosystems and their services.

Figure 24: Master of an instrument factsheet

French Evaluation of ecosystem and ecosystem services Evaluation française des écosystème et des services écosystémiques (FR)	
GENERAL DESCRIPTION	
Formal/informal character:	informal
Type of instrument:	Voluntary approaches
Subtype of instrument:	Voluntary cooperation and commitment, not legally binding
Spatial level:	transnational, national, regional, local
Stakeholders:	national authority, local authority, sectoral agency, interest groups, higher education, SMEs and private companies and owners, general public
General objectives:	The national nature
Responsibility:	National authorities
RELATION TO THE ES APPROACH IN GENERAL	
Status of ES involvement:	Yes
Suitability:	Yes
Suitability justification:	Yes, because it is mainly a tool to communicate with general public or its representatives
Consideration:	By making an explicit reference to the ES concept and favoring the integration with other instruments (normative and non normative ones) that might support ES (labeling, information and awareness raising, access fees, availability of funds, etc.)
ASSESSMENT OF THE INSTRUMENT IN ITSELF	
Acceptance by target groups:	national, regional and local authorities
Effect on decision making:	yes
Level of effect on decision making:	high
Transferability:	yes
Scalability:	Yes
ASSESSMENT OF THE INSTRUMENT REGARDING ES-IMPLEMENTATION	
Chances:	To integrate ES for the valuation of ecological accounts in France
Limitations:	Theoretical concept seems to be too far from practice; higher complexity, commodification, unequal consideration of different ES
Transnational implementation requirements:	Need to establish an Alpine wide sustainability strategy
Added value for ES:	Need to establish an Alpine wide sustainability strategy

Tools provided in AlpES

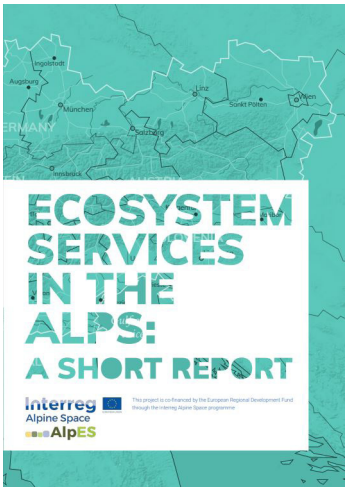
What results and tools have been developed within the AlpES project? To provide a basis for the application of the ecosystem service concept in the Alpine area the project delivered several different tools:



Framework for a common understanding:

This captures and summarizes the ongoing debate about the ecosystem service concept. The results related to a common understanding, mapping and assessment, and instruments are available as summary "digests".

They can be downloaded at
http://www.alpine-space.eu/projects/alpes/en/infoservice/downloads



Ecosystem service indicators, data and maps

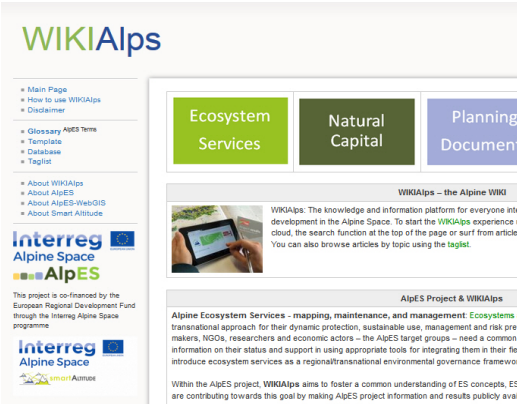
Indicators have been developed for eight selected ecosystem services, and alpine-wide data have been collected and processed. The results are presented as maps that provide the average value for the ecosystem service provision at a municipal level. Results are presented in this short report.

See: http://www.alpine-space.eu/projects/alpes/downloads/alpes_report-_web-view-to-download-.pdf

Web GIS

Data for the selected ecosystem services are presented as maps. To offer the interactivity of a GIS, the maps are accessible via a WebGIS and its tools for map presentation and spatial analysis can be used.

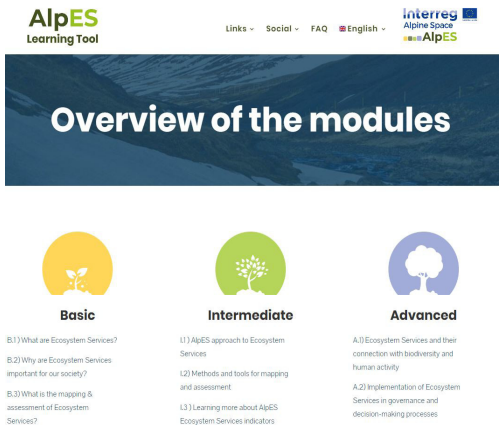
See: http://www.alpes-webgis.eu/



Documentation in WIKIAlps

WIKIAlps is a wiki that provides expert information on environmental management in the Alpine Space. It is also a well-established tool for knowledge dissemination. The wiki explains the approaches and different terms of the ecosystem service concept.

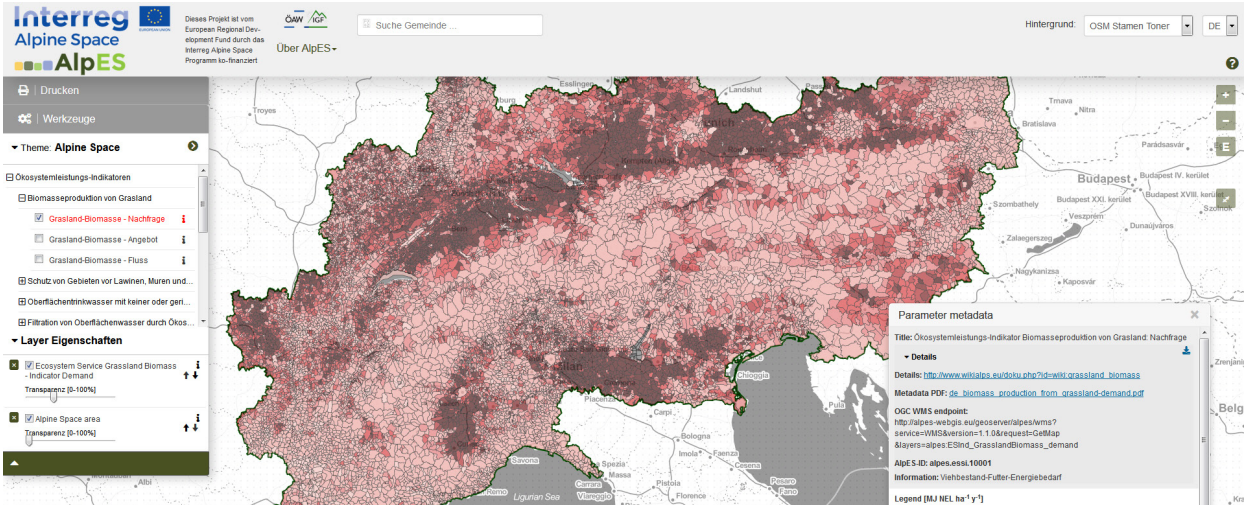
See: http://www.wikialps.eu/doku.php



Learning tool and capacity building model

Together with the scientific-based analysis of ecosystem services, the AlpES project has also developed a capacity building model that uses a learning tool to disseminate knowledge about the ecosystem service concept and its application options. The learning tool provides different knowledge levels by dealing with the main issues required for an understanding of the ecosystem service concept; it also provides specific, alpine case studies.

See: http://www.alpeselearning.eu/



Application in test regions

Together with the analysis of alpine-wide data, ecosystem services have also been analysed at a regional scale in nine test regions (cf. Figure 25). Results of studies in the test regions are presented in the Final Publication: Ecosystem Services and governance in the Alps.

The focus for each of the test regions varied according to needs identified at a regional level:

* Corona Verde (IT) introduced the ecosystem service concept and used it to improve and reshape spatial planning in their region.

* In Primorsko-notranjska (SI) all developed ecosystem services indicators were tested and maps were prepared. Additionally, a regional-specific questionnaire for symbolic species and landscapes was developed and possibilities of implementing the concept were tested.

* Alto Bellunese (IT) selected two relevant ecosystem services for that area and focused on supply, demand and flow of the outdoor recreation status, which is highly relevant for this area.

* The Espace Mont-Blanc (IT) is a transboundary area that includes part of the Aosta Valley (IT), Haute Savoie and Savoie (FR) and Valais (CH). The Aosta Valley was chosen as core space of this area. The ecosystem service concept was applied at a sub-regional level and all developed ecosystem services were tested.

* In the Parc naturel regional des Préalpes d'Azur (FR) eight important ecosystem services were identified to map these ecosystem services and to assess their monetary value, too.

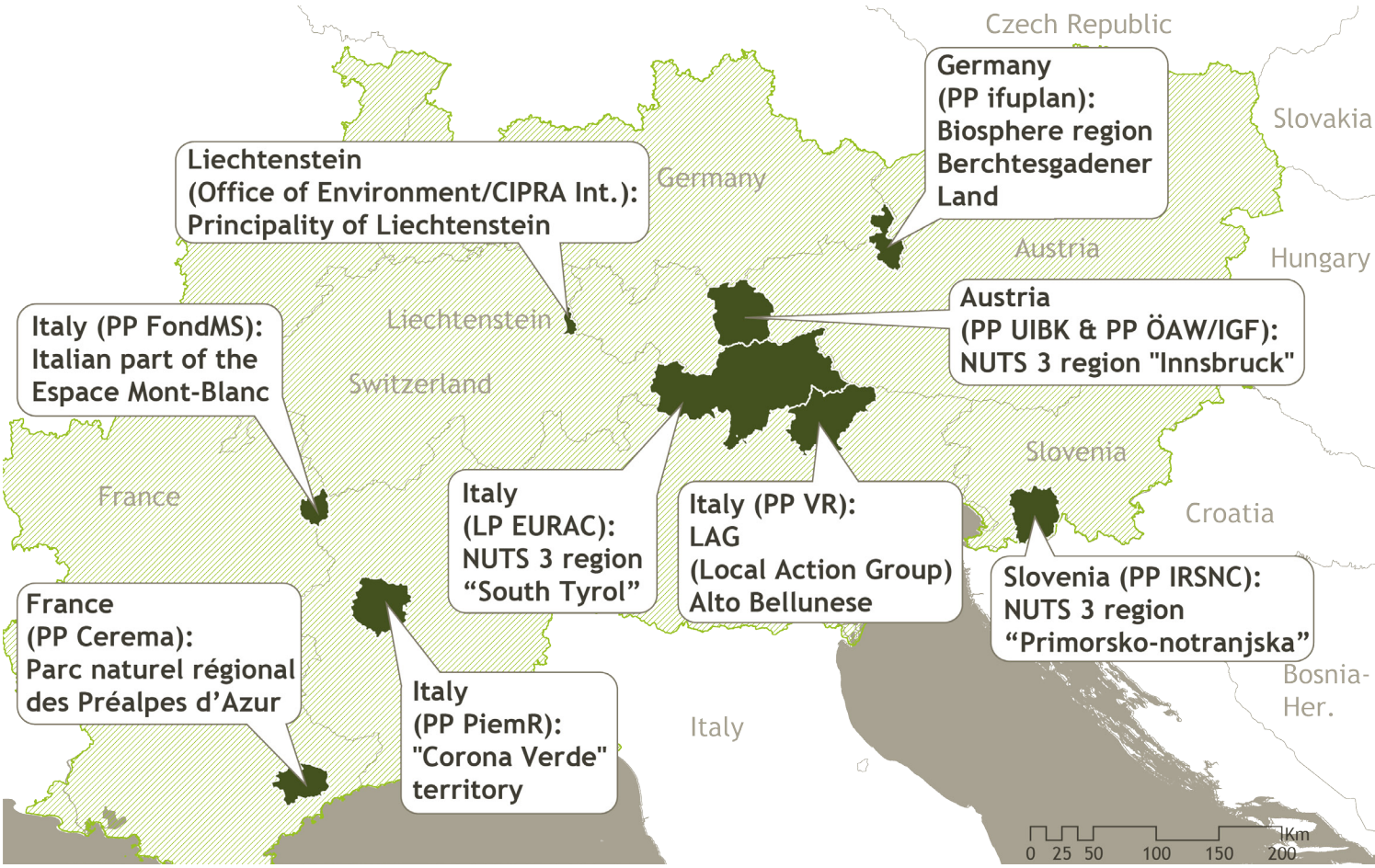
* The region South Tyrol (IT) approached the concept of ecosystem services on two ways. On the one hand, they had a look on ecosystem services on the municipal level, on the other hand they had done resolution maps and mapped ecosystem services on pixel level. Both ways focused on flow, supply, demand and budget.

* The Innsbruck Region (AT) focused on the analysis of ES trade-offs. ES trade-offs were assessed by quantifying correlations between the eight Alpine ES. Furthermore, a participatory workshop measured stakeholder perceptions of ES trade-offs in the test region.

* In the Berchtesgadener Land (DE) Biosphere region indicators related to human health and recreation were defined and regional expertise was used to map ecosystem services.

* In the principality of Liechtenstein (LI) the test region was divided into 3 areas while each of them focused on the monetary value of ecosystem services and the comparison with existing costs.

Figure 25: Test regions of the AlpES project


Czech Republic
Germany
(PP ifuplan):
Biosphere region
Berchtesgadener
Land
Slovakia
Liechtenstein
(Office of Environment/CIPRA Int.):
Principality of Liechtenstein
Germany
Austria
Hungary
Austria
(PP UIBK & PP ÖAW/IGF):
NUTS 3 region "Innsbruck"
Italy (PP FondMS):
Italian part of the
Espace Mont-Blanc
Liechtenstein
Switzerland
Slovenia
France
Italy
(LP EURAC):
NUTS 3 region
“South Tyrol”
Italy (PP VR):
LAG
(Local Action Group)
Alto Bellunese
Croatia
Slovenia (PP IRSNC):
NUTS 3 region
“Primorsko-notranjska”
France
(PP Cerema):
Parc naturel régional
des Préalpes d’Azur
Bosnia-
Her.
Italy
(PP PiemR):
"Corona Verde"
territory
Italy
0 25 50 100 150 200
Km

5 / p. 40:
The term “regional environmental governance”,
Brandes, O. & Brooks, D. B. (2005). The soft path in a nutshell.
Victoria BC. p. 8

6 / p. 42:
italian decree n. 6513 of 18 November 2014 on the
implementation of Regulation (EU) 1307/2013

Figure 16:
Decisions taken by human society lead to changes in ecosystems and their service provision (e.g. forest clear-cuts and the loss of forest ecosystem services), and the provision of services has effects on human society (e.g. changes in water run-offs for agriculture and economy). AlpES

Figure 17:
Main advantages and limitations of the ecosystem service concept
AlpES

Figure 18,19,20,21,22:
ifuplan

Figure 23:
Potential target groups for the implementation of the ecosystem service concept

Figure 24:
Master of an instrument factsheet, AlpES

Figure 25:
Test regions of the AlpES project
https://www.alpine-space.eu/projects/alpes/en/test-regions

Figure 26: Perspectives for mountain areas and potential ecosystem service implementation, ifuplan


GELD EINWERFEN. DANN KNOPF
BIS ZUM ANSCHLAG DRÜCKEN.
KEINE RÜCKGABE UNKORREKTER MÜNZEN.
INTRODUIRE LA PIECE DE MONNAIE.
APPUYER SUR LE BOUTON.
LES FAUSSES PIECES NE SONT PAS RESTITUEES.
1x1 Fr.
oder - ou - o
1x1 €
1x2 Fr.
oder - ou - o
1x2 €
EUROSCOPE
Beck & Co. AG

CONCLUSIONS OF THE ALPES PROJECT

At the end of the AlpES project a few preliminary conclusions can be drawn regarding the status of ecosystem service implementation, its opportunities and challenges, the need for harmonisation, and further development options:

Status of ecosystem service implementation in the Alpine area

An analysis of environmental awareness research in the Alpine countries showed that citizens are mainly aware of biodiversity, and of the dependence of human well-being on nature and its resources. Even if the term "ecosystem service" is not explicitly used, there is a common ground for the ecosystem services concept.

* Successful implementation of the ecosystem service approach can foster greater consideration of environmental issues, a change in governance, and can help meet transnational environmental challenges.

* To achieve this transdisciplinary vision, it is essential there be a common understanding of the ecosystem service concept among different stakeholders. This requires that knowledge about the ES concept be communicated and disseminated, underscoring its benefits and added value for regional and local environmental governance. The AlpES project has produced papers that foster such common understanding.

* Several instruments that are already available in the different Alpine countries could be used to integrate the results of an ecosystem service assessment or to apply the ecosystem service concept to parts of these instruments.

Chances and Challenges for an implementation

The opportunities and challenges the AlpES project has identified for the implementation of the ecosystem service concept are summarised as follows:

* The ecosystem service concept offers the option of developing a common framework for decision-making, even though further work will be needed in this respect.

* There are some indications that the analysis of demand and flow of ecosystem services is often neglected despite offering considerable potential for decision support.

* For the time being, it will be difficult to achieve an evaluation or comparability of the provision of ecosystem services as in many cases no real benchmarks exist. The latter will, however, be needed to move ahead from the analysis of ecosystem services to actions.

* Promising results for the implementation of the ecosystem service concept do exist; time is, however, running out while other trends like climate change are accelerating.

* Identifying the ecosystem services of a region may also strengthen regional identity, as well as self-awareness and responsibility among civil society, political representatives and administrative authorities within the region.

Figure 27 / ifuplan

Need for harmonisation and further development
What need is there for further harmonisation of the ecosystem service concept in the Alpine area? What further, promising developments can be envisaged for the implementation of this concept?

* The AlpES project has selected eight ecosystem services for which it has developed and tested indicators. It has been demonstrated that such indicators can be calculated both at an alpine-wide and at a regional level. However, to achieve broader implementation and decision support, a standardised set of ecosystem services may be needed to benchmark and compare developments in the Alpine area.

* The AlpES project gathered an extensive collection of potential implementation instruments. It would certainly be useful to achieve further harmonisation and develop a common framework so as to identify how ecosystem services will be applied in future and what kinds of instruments will be needed. Such a framework could be adopted at a transnational level in the Alpine countries.

* As a next step, common objectives for the maintenance of ecosystem services are needed. Therefore common work on developing measures for ecosystem service provision and setting appropriate goals needs to be undertaken. This should be done while at the same time considering existing environmental goals and standards that are based on a legal framework.

* A further step might be to develop a scheme to establish a form of regional environmental governance based on ecosystem services. In this sort of approach, links and interfaces to other aspects of sustainable development should be considered. By adopting such an interlinked approach, it might be possible to merge a variety of Alpine Space initiatives into a common approach: e.g. the Green Economy, environmental and social justice, biodiversity protection, Green infrastructure, climate change adaptation, and the integration of migration effects.