



**ECOSYSTEM SERVICES
IN PROTECTED KARST
AREAS**

Ecosystem services in protected karst areas

Publisher:

Centre for Ecological Research - Hungarian Academy of Sciences in the framework of ECO KARST project, supported by the Interreg Danube Transnational Programme and co-financed by European Union funds (ERDF and IPA)

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Cover photo:

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Electronic version available at:

www.interreg-danube.eu/approved-projects/eco-karst/outputs

May, 2018

This publication has been produced within the “ECO KARST – Ecosystem services of protected karst areas- driving force of local sustainable development” project, implemented through Interreg Danube Transnational Programme and co-funded by European Union funds (ERDF and IPA).

Suggested citation: Arany I., Aszalós R., Kuslits B., Tanács E. 2018.: Ecosystem services in protected karst areas. Interreg Danube Transnational Programme, ECO KARST project

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Introduction

Karst is a general term used for unique landscapes with specific features (caves, sinkholes, springs, sinking streams), formed on soluble, mostly carbonate, bedrock as a result of the dissolving action of water. Karst landscapes are characterised by a variety of weathering rocks, surface depressions, underground drainage, and surface streams. The variability of surface forms results in an extraordinary richness of wildlife.

The karst areas of the Danube region provide unique habitats, clean water, beautiful landscapes and livelihoods for people, a result of a harmonious and balanced long-term coexistence between man and nature. This harmony is not only a beautiful legacy and cultural value, it also brings concrete benefits to people and society as a whole. The scientific community calls these benefits “ecosystem services”, which are essential goods that nature provides to humans.

The EU Interreg DTP project ‘Ecosystem services of karst protected areas – driving force of local sustainable development’ (ECO KARST) involves seven protected karst areas in seven different countries with common features and similar challenges. One of these challenges is the lack of precise knowledge on the benefits provided by nature. The main objective of the project is to contribute to the protection and sustainable development of karst bio-regions in the Danube basin, based on their valued ecosystem services. Thus, one of the project’s central activities is the mapping and assessment of these services in seven pilot areas: Notranjska Regional Park (Slovenia), Nature Park Žumberak-Samoborsko gorje (Croatia), Bükk National Park (Hungary), Apuseni Nature Park (Romania), Protected Landscape Bijambare (Bosnia and Herzegovina), Tara National Park (Serbia) and Kalkalpen National Park (Austria).

An important aim of the ECO KARST project is to examine how ecosystem services can contribute to the profitability and sustainability of different economic sectors, such as forestry, agriculture or tourism. During our work, we analyse the role of different sectors in preserving nature in a way that can contribute to human well-being in the future as well.

We believe that the best way to reach our goal is to involve various local public and private actors. Local people will jointly develop local action plans for the development of a nature-friendly economy, or in other words, Pro Biodiversity businesses in each pilot area, based on the sustainable management of vulnerable karst ecosystems. During the project, our fundamental goal is to generate locally usable, practical results.

We recommend our short booklet to all those who think responsibly about the future of these unique and fragile regions, wish to find a realistic alternative to preserve their natural assets, and make a difference in the regions’ life through their conscious activities.



The gifts of nature

Ecosystem services are gifts that nature provides for us. The concept of ecosystem services aims to capture the complex relationship between nature and society in a simplified way. To achieve this, it borrows an analogy from economy: a provider (the ecological system) offers various services to a beneficiary (society). These gifts – such as the trees and fruits of the forests, forage and shelter for animals, or a safe, clean and beautiful environment to live in – are not only useful, but vital for us as individuals and as a society, including the healthy functioning of local communities.

What are ecosystem services?

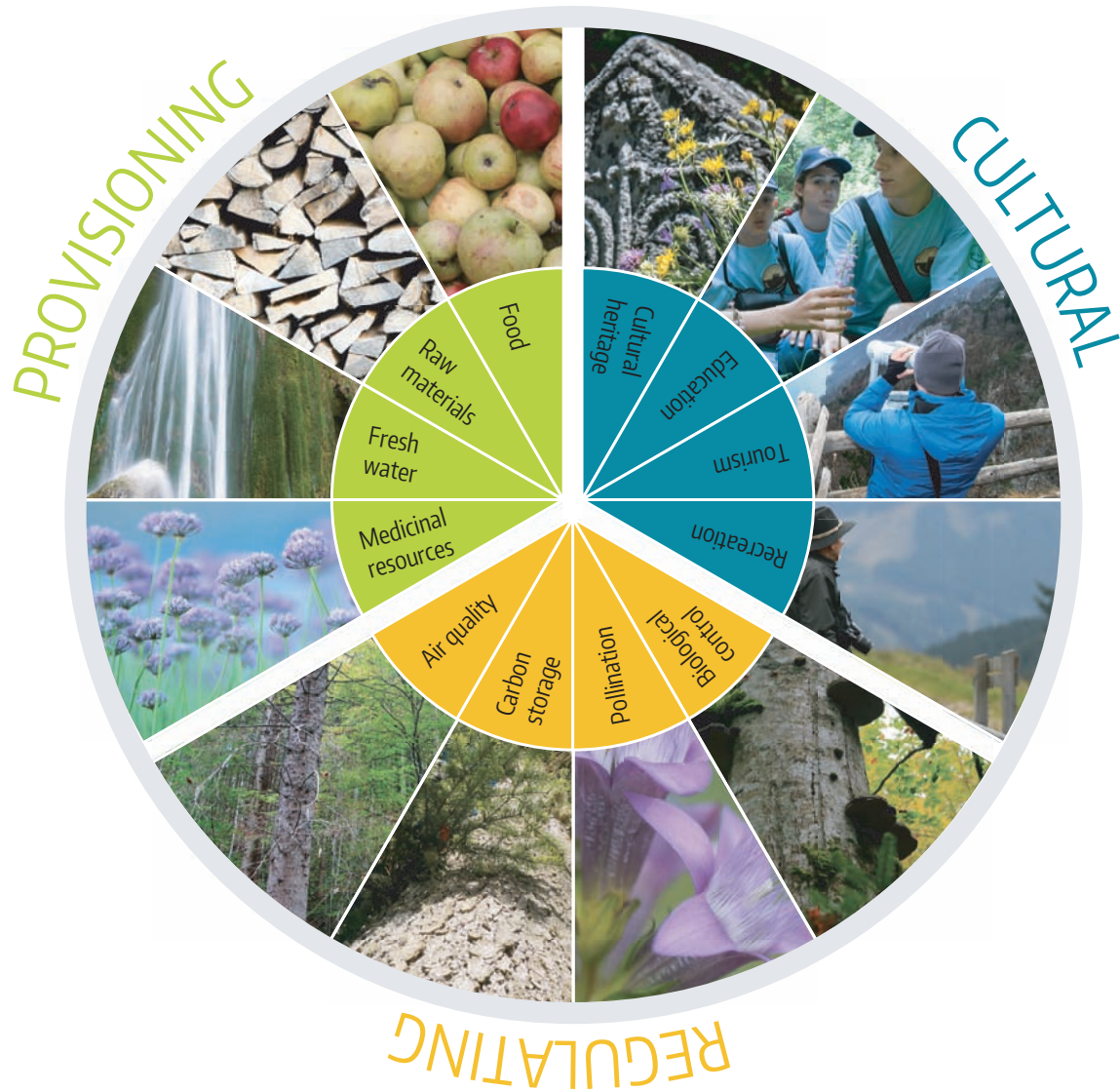
Since we do not fully understand the degree of our dependence on these services, and the way our decisions influence them, we often unintentionally and unexpectedly harm them. As a consequence, their loss heavily impacts nature, economy and the wellbeing of people. The recognition of this made the concept of ecosystem services break into mainstream science in the early 2000s.

Since then, it has been taken into consideration in many important nature conservation policies on international and EU level. One of the most important policies is the EU Biodiversity Strategy to 2020. It lays down the mapping and assessment of ecosystem services and their integration into decision-making processes as a concrete goal and responsibility of all EU Member States. This strategy fundamentally determines the key directions of national biodiversity strategies in the EU Member States.

Science classifies ecosystem services into three categories:

- Provisioning services – material products provided by the ecosystems, such as food, grains, fruit, fuel, fibre (timber, wool), herbs, natural medicine, ornament materials (flowers, clams), etc.
- Regulating services – ecosystem processes providing stable and safe living conditions, such as air quality regulation, climate regulation, erosion regulation, water purification, regulation of diseases, pest control, pollination, regulation and mitigation of floods etc.
- Cultural services – non-material benefits provided by ecosystems, such as spiritual enrichment, cognitive development, inspiration, relaxation, social connections, cultural heritage, aesthetic experience and ecotourism.

The concept of ecosystem services offers a common platform between various fields of science and policy. Furthermore, it is suitable for translating the complicated processes and connections between man and nature into a simple language comprehensible by many. To achieve this, it is necessary to help the idea enter both everyday communication and decision-making.



The flow of goods from nature to society

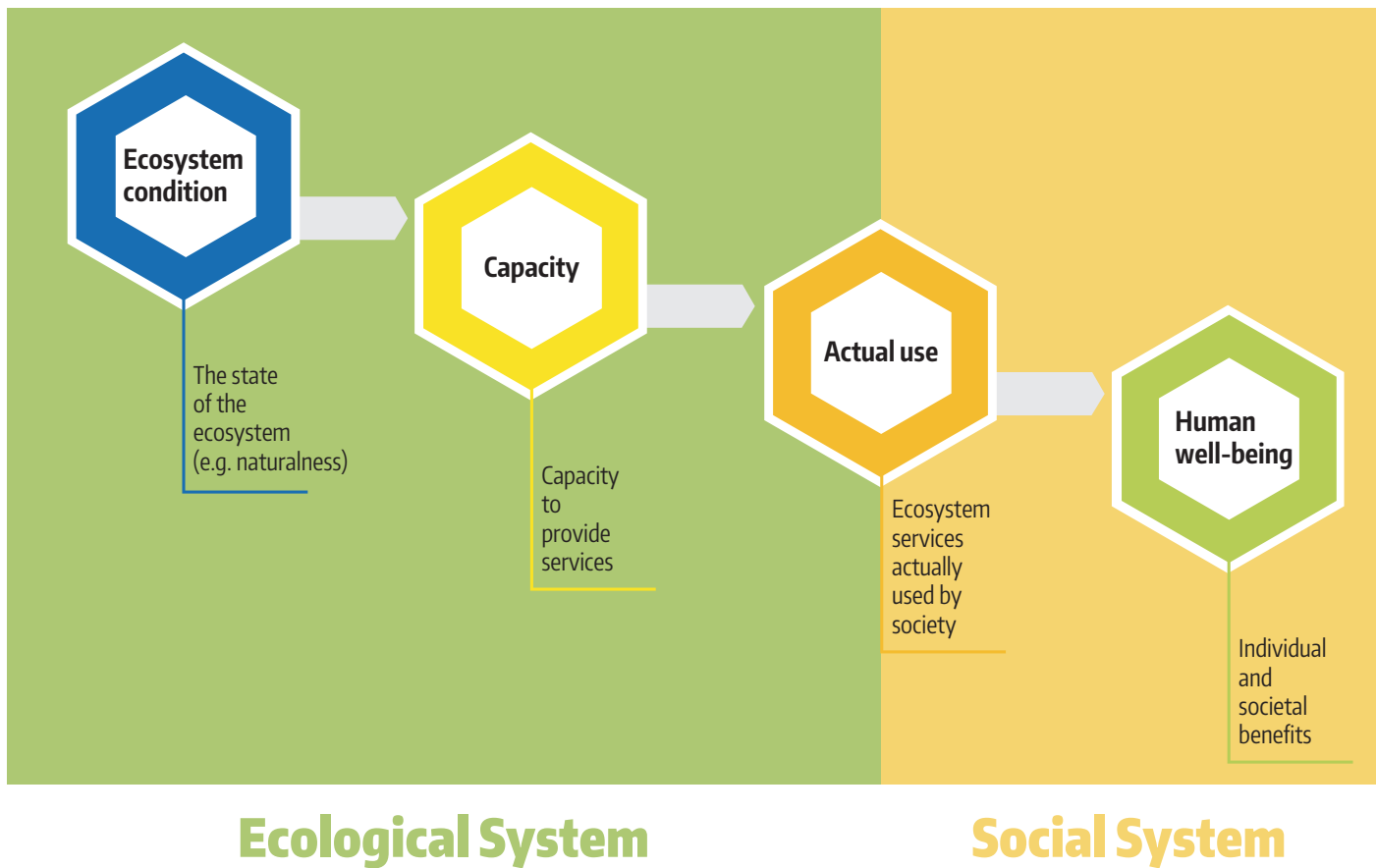
Ecosystems depend on many different processes that sustain them. Bacteria and fungi decompose deadwood, deer graze meadows, wolves hunt deer. It is a miracle that nature never produces waste, and it is the consequence of cooperation between these actors: something is produced by one of them, the other contributes, the third feeds on it and the fourth turns it to soil full of nutrients. In the cycle of life, ecosystems use the energy of the sun which is first used by plants, but later distributed among all beings.

An undisturbed natural habitat constantly accumulates a variety of goods. Humans can be a part of this balance in many ways and can take advantage of all the processes without endangering the system itself, if they respect the limits of sustainable use. If we wish to assess the ecosystem services provided by a certain area, the very first thing to study are the integrity and functionality – in short, the condition – of its ecosystems. The good condition of ecosystems is not yet considered a service itself, but it is indispensable for any service directly used by people. Ecosystem condition is the first level in the flow of services from nature towards society. Condition defines the ability of ecosystems to provide services, which, at this point, is just a capacity to do that. Pressures from human activity, such as, for example, pollution or too intensive use, may have an impact on ecosystem condition and thus reduce this capacity. Only when this capacity is truly utilised can we talk about the actual use of ecosystem services. The benefits of the services used then appear in the form of maintained or increased well-being in society. This four-level model is called the cascade model. To understand the cascade model, let us have a look at some examples. The first example is the case of timber provision. Nature, just by ensuring a favourable environment for trees to grow (ecosystem condition), creates a lot

of woody biomass, which is potentially a very valuable raw material (ecosystem service capacity). Different ecosystems have different conditions and therefore different capacities, e.g. a steep, rocky slope will usually be able to provide less timber than a valley with deep soil. Once the trees are harvested, a certain mass of timber is produced (actual use of ecosystem service). If a company is processing timber, it is creating profit and is providing work and income opportunities, thus contributing to the well-being of people. Of course, the forest is not only important for its marketable products; it also provides a range of other ecosystem services, such as recreation opportunities (another dimension of well-being), ensuring a clean and safe environment, contributing to the mitigation of climate change and creating a home for a large number of plants and animals.



The cascade model





A second example is water purification. There are many living beings – plants, animals, bacteria, fungi or algae (ecosystem condition), most of them invisibly small, which cooperate to regulate the balance of the important ecosystem function of filtering and decomposition of waste (ecosystem service capacity). Once a polluting substance is released into the environment, these organisms contribute to fixing, storing or decomposing it within their capacity to do so (actual use of ecosystem service).

Thus, ecosystems are able to protect rivers, lakes, wells and springs from a certain amount of pollution, ensuring the supply of clean water for drinking or other uses (well-being). If these organisms are destroyed or weakened, or the soil cover is eroded, the ecosystem will not be able to provide this service anymore at all or not at a sufficient level.

Our third example for ecosystem services is tourism attractiveness. Nature is beautiful. Karstic landscapes with their caves, barren rocks,

steep canyons and mountain meadows (ecosystem condition) are especially attractive for tourists (ecosystem service capacity) who visit these places (actual use of ecosystem service) to enjoy their beauty and experience various outdoor activities (well-being).



Ecosystem services in everyday life



Human life and activity depend on ecosystems. The services provided by ecosystems, such as food, drinking water and clean air, are essential contributors to human well-being, social cohesion and economic development.

We enjoy the beneficial contributions of nature in our everyday life often without recognizing them. Whenever we open the tap to fill a glass with water, seek respite from the summer heat in the shadow of a tree, or take a picture of a flower, we are unconsciously taking advantage of the different services of nature.





Ecosystem services and economy

Ecosystem services are often taken for granted and considered free and everlasting, while they are in fact finite and as such can be overused. They are even easier to overlook when the benefits are enjoyed by people who are far away from the ecosystem providing the service. For example, older, bigger trees are more effective at purifying the air than smaller, younger trees.

Old forests also store a lot of carbon both in the trees and in the soil, which eventually gets back into the atmosphere when the trees are cut down. And yet a farmer, who does not fell his forest at an early age for higher profit, usually does not get any compensation for his various contributions to public well-being. We use ecosystem services without many of the benefits and real costs being accounted for in the markets. Thus, there is a great need for a tool to communicate the importance of the protection of nature and its benefits to society, decision-makers and market actors in terms they understand.

The economic valuation of ecosystem services can be such a tool. It needs to be handled with care – there are a lot of values, which are very difficult to monetize and are inherently subjective. Who can determine the real aesthetic value of a wildflower meadow? Beauty is in the eye of the beholder. It is also a dangerous path to set a price to everything; it could lead to thinking that public goods can be sold and bought. Therefore, the aim of economic valuation of ecosystem services is not to define an exact price, but rather to raise awareness to the ecosystems' contribution to human well-being, to the extent of this contribution, and to the true costs of those activities that lead to the degradation or loss of certain ecosystem services.





Pro Biodiversity businesses

Nature can contribute to human economy, and the value it creates also depends, especially in the long term, on how we use it. All human activities are to some extent dependent on nature, but some – for example agriculture, forestry or nature tourism – are more directly so than others. The performance of these activities is basically determined by the condition of nature, which greatly depends, particularly in the long term, on how sustainable the way we use it is. A Pro Biodiversity business is dependent on biodiversity for its core business, and even contributes to biodiversity conservation. One of the core goals of ECO KARST is to motivate the creation of new local business models that use existing ecosystem services more sustainably and secure local livelihoods at the same time. Examples of Pro Biodiversity businesses and the way they are fostered during the project are presented in another ECO KARST publication¹.

Ecosystem services in decision making and conflict resolution

Ecosystems provide multiple services and often fulfil multiple functions. Different sectors and different stakeholders take advantage of the different benefits, and sometimes they have conflicting interests. In many cases, this can lead to disagreements about the choices between land use alternatives; these alternatives, just like the services they utilize, are often mutually exclusive, or in other words, they are a trade-off. Some benefits are more visible than others, and when a decision needs to be made about trade-offs, the less evident services are often overlooked. Let us look

at some examples. If the number of game in an area is increased, this may be good for hunting, but it eventually leads to increased costs for forestry or agriculture because the seedlings or the crops are eaten up. Therefore, the number of game in an area cannot be increased indefinitely; a limit must be set. Erosion prevention and water regulation are services which heavily depend on forests; thus, too much logging may not just endanger future generations' ability to harvest timber, but also jeopardize an important defence against landslides, floods or droughts. Regulating services are usually much more complex than provisioning services. If the emphasis is put too much on the latter, and other services are ignored, the sustainability of the ecosystem and its long-term survival may be endangered. It is the responsibility of the decision-makers to promote sustainable use so that all the benefits can be enjoyed, even by the next generations.

Assessing ecosystem services of an area helps the decision-makers and the stakeholders to understand nature and make better decisions on how to use the land. Time may bring changes to an ecosystem, and the benefits it can provide may shift between services. If, for example, a meadow is abandoned and not grazed anymore, it will first be occupied by shrubs, and then trees. Its capacity to provide fodder or habitat for certain rare butterflies will decrease, but its capacity to provide wood, store carbon or protect the soil from erosion will increase. Such cases again need careful consideration by decision-makers and landowners. In a heavily forested area, investing into keeping some habitats open for some rare species may generate more benefit in total, compared to having another reforested patch. The assessment of ecosystem services may help raise awareness to such aspects of land use decisions.

¹ Available at: www.interreg-danube.eu/approved-projects/eco-karst/outputs



How can we assess ecosystem services?

Nature provides a wide range of different ecosystem services for the local population. In order to assess the value that ecosystem services represent to the local community, the following steps need to be taken:

1. Identifying the most important ecosystem services

If the aim is to identify the most important ecosystem services of a given region, the simplest and most effective way is to ask the local stakeholders on their perceptions on nature's contributions to their life. It is important to address as many stakeholder groups as possible to unfold the whole perception range of the locals.

This can be complemented by online or personal interviews, which contribute to a priority list of ecosystem services. To structure the priority list, we can use an existing ecosystem service classification system, but we may customize it by merging services or even identifying new ones.

2. Mapping ecosystem types

As a first step in locating and mapping ecosystem services, we need to delineate spatial units (e.g. habitats, land use types), which will serve as a basis of our assessment. The units we use depend on the ecosystem services we wish to map. For certain services (especially provisioning services such as honey), specific data or maps may

already exist (e.g. area of certain plants which are especially valuable for bee pastures), while more generic habitat or land use maps can be used for others. Such maps are either available from different national or European agencies or they can be created for the purpose.

3. Mapping ecosystem service capacities

We define the capacity of an ecosystem to provide a certain service by formulating a model. Such models may be based either on scientific literature or the knowledge of local experts, or both. They describe the complex relationships of environmental components, the physical, biological, chemical qualities that determine the capacity of an ecosystem to provide a certain service.

Models are usually based on the previously identified habitat types, but other environmental spatial data can be used if considered relevant for the particular service. If we take the example of honey production, then habitat type, habitat naturalness, landscape diversity, soil fertility and grazing intensity can be important components which define the value of a bee pasture. Interviews with experts – beekeepers in this example – can help in estimating the amount of nectar available for bees depending on these factors. The results of the models are used for visual representation (mapping) of the services.



4. Assessing the actual use of ecosystem services and their economic benefits

While capacities show the potential availability of services, actual use shows how much of that potential is actually utilized. This is most often based on local statistical data, or questionnaire surveys. If we keep the example of honey, local municipalities and beekeepers' organizations can provide information on the number of bee hives placed in a certain area, whereas interviews with beekeepers can help in estimating the average honey yield of a hive in a certain year.

All this adds up to the aggregated amount of honey produced in a given area or time period. Once this aggregated information on actual use is available, it is relatively easy to define the economic value.

This is true of most provisioning services, because the produced goods are usually traded and therefore priced. It is much more challenging to evaluate regulating and cultural services in economic terms. In these cases, so-called non-market methods are used.

Some of these methods examine the amount of money spent on goods related to ecosystem services – this gives an indication of how high people actually value that service. Take the example of tourism attractiveness.

Tourists sometimes travel from great distances just to be able to see and enjoy a certain landscape or its specific features (such as caves in a karst, or birds in a wetland). While they are there, they spend their money supporting the local community (for accommodation, food and all types of services). The amount of money spent is not exactly the value of the service, but it is a good indication of its importance.

However, economic value is just one component of human well-being. To achieve the most extensive valuation of services, monetary valuation is sometimes supplemented with social valuation, which means understanding the role of each service in the local community and their benefits other than monetary.

For example, a beautiful landscape or a certain traditional way of using nature's goods may be part of the local identity of people, and it may play a role in local history or folk songs, the value of which cannot be expressed in money.



Why should a karst protected area assess its ecosystem services?

Karst areas are special. They are very important sources of water – a significant part of the world's population gets their drinking water from such systems. Because water can travel fast through the sinkholes, fissures and cracks in the bedrock, it is partly the vegetation but mainly the soil cover that act as the main filter and buffer for pollution. After getting inside the karst rock, some of the water can be stored underground but most of it comes back to the surface with some delay in the form of springs.

For this reason, karstic systems are very sensitive to pollution. They can only provide drinking water free of charge as long as the state of the ecosystem is good enough to be able to purify the water.

The most important threats to karstic watersystems are pollution from agriculture, such as too much use of fertilizers, sewage and municipal waste, as well as the loss of soil cover due to erosion. The value of clean water for humans cannot be overstated. If karst systems did not provide it, water would need to be transported from large distances and probably would need to be purified by means of costly technological solutions. If we add up the costs of water transportation and cleaning, it becomes immediately clear how valuable the karstic system is to the local communities in economic terms.

The high sensitivity of karst to degradation (such as soil erosion and the ensuing loss of water retention ability) became apparent in the past during forestry and agricultural overuse. As a result, instead of fertile areas rich in biodiversity - barren rocky surfaces emerged.

These were not suitable anymore to provide for the needs of the local population. In some European countries, protective legislation was formulated as early as the 19th century, aiming at preventing further deterioration of the condition of such sensitive areas. These days, many of our karst areas enjoy some form of protection. As a result, degradation may have stopped; however, regeneration is very slow. Karst regions often struggle with economic and social issues, and as a result, depopulation.

Generally, forestry and grazing are the most important economic activities in these areas, but karst regions provide a range of other services as well, some of which could be further exploited. Karst areas often boast a unique richness of wildlife and special habitats, due to which they play an outstanding role in nature conservation.

The natural beauty of landscapes and wildlife, and specific features such as caves or rock formations attract a large number of visitors. Tourism, especially ecotourism may partly complement and partly replace low-profit agricultural occupations. The provision of drinking water and the role of karstic forests in climate regulation (including carbon sequestration) are services where the benefit is not limited to the karst area itself. However, the role of karst areas is often overlooked. Assessing ecosystem services of these areas may help to increase awareness of their importance, reveal unexploited resources or help identify trade-offs. These can help the local stakeholders and decision-makers to make a better use of their resources and increase quality of life for the local population.

WHY SHOULD A KARST PROTECTED AREA ASSESS ITS ECOSYSTEM SERVICES?



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Project co-funded by European Union funds (ERDF and IPA).
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