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# Mapping and assessing ecosystem services in Natura 2000 sites of the Niraj - Târnava Mică region


## *Project report*

Tg. Mureș
2017

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ISBN 978-973-0-24530-1

Suggested citation for the chapters:

> <Chapter authors> (2017): <Chapter title>: Mapping and assessing ecosystem services in Natura 2000 sites of the Niraj - Târnava Mică region - Project report. Milvus Group – MTA ÖK – CEEweb, Tg. Mureş, Romania, xx-xx pp. Available from: http://milvus.ro/ecoservices/images/maesprojectreport.pdf

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Tg. Mureș, Romania
2017

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# About the project

You are holding the detailed summary report of the "*Mapping and assessing ecosystem services in Natura 2000 sites of the Niraj - Târnava Mică region*" project (Niraj-MAES) in your hand. The project was generously supported by the EEA Grants 2009-2014 with the contribution of the Romanian Ministry of Environment, Water and Forests. The implementation is led by Milvus Group Association, with contribution from the partner organizations Centre for Ecological Research of the Hungarian Academy of Sciences (MTA ÖK) and CEEweb for Biodiversity, the Hungarian representative of the network of European nature conservation NGOs.

The project's eligible budget is 402 340.41 EUR, 60 351.06 EUR of which is the Romanian state's contribution through the "RO02 Programme on Biodiversity and Ecosystem Services" of the Romanian Ministry of Environment.

For more information about the EEA Grants, please visit the following websites:

www.eeagrants.org, www.eeagrantsmediu.ro, www.eeagrants.ro.

The present report gives detailed insight into the whole process of mapping and assessing ES in the Niraj - Târnava Mică region. In order to make each chapter readable and understandable on its own - without having to read the whole report - some parts/sections can be found repeatedly, in more than one chapter.

## Project partners

The project was led by Milvus Group, Romania working in cooperation with MTA ÖK and CEEweb for Biodiversity.

Milvus Group Association is a non-profit, non-governmental organization, acting in fields of nature conservation, research, education and advisory work. It has participated in many projects including the designation of the Romanian Natura 2000 network, several species protection, educational and regional development projects, and it also operates a bird rehabilitation centre. It manages several Natura 2000 sites. It thus takes part in the management of the Natura 2000 sites in the Niraj - Târnava Mică region, where the research for the present study was conducted. Milvus Group leads the project and is mainly responsible for data collection, stakeholder engagement and management of the project.

The MTA ÖK (Centre for Ecological Research of the Hungarian Academy of Sciences) is engaged in basic and applied research in ecology and conservation biology in Hungary. MTA ÖK has a long tradition of studying complex policy-oriented research questions, and conducting regional ecosystem assessments in policy sensitive landscapes. MTA ÖK has a key role in providing scientific support for the Nature administration of the Hungarian government, including Mapping and Assessment of Ecosystem Services (MAES) activities. MTA ÖK is running the scientific assessments and the mapping of the ecosystem services.

CEEWEB is a network of 50 nature conservation NGOs from the Central and Eastern European region working for 20 years in 20 countries. The organization's mission is the conservation of biodiversity through the promotion of sustainable development. As mostly working with stakeholders and biodiversity policy, CEEweb is mainly responsible for the policy analysis and communication.

# 1. Introducing the project “Mapping and assessing of ecosystem services in Natura 2000 sites of the Niraj - Târnava Mică region” - Niraj-MAES

***Márton A. Kelemen, Ildikó Arany, Bálint Czúcz, Katalin Kelemen, Judith Papp***

## 1.1 Background of the research

The area of the presented research consists of four Natura 2000 sites in Eastern Transylvania, which are representative of both the typical habitat types as well as the traditional land use techniques of the region.

While working on different research and conservation projects in the area for the last 20 years - partly during their involvement in the administration of these Natura 2000 sites - the Milvus Group Association has experienced a lot of conflicts of interests between the administrator and the land-users. By using the concept of ecosystem services we intended to create some common ground for balanced planning and decision-making processes and thus contribute to an improved quality of life in the region.

During the two-decade work of the Milvus Group in the region a great amount of data and background knowledge of the area accumulated, of which the project benefitted greatly. By evaluating the ecosystem services of the region we also contributed to the national and EU level MAES processes as well as to the implementation of the EU Biodiversity Strategy.

The methodology used allowed us to assess ecosystem services in a complex manner. We designed a participatory research methodology, combining the techniques of social and environmental sciences, in which the traditional knowledge and values of the locals were highly prized.

### 1.1.1 The traditional landscape of the Niraj - Târnava Mică region

The mosaic landscapes of Transylvania hide unique natural values, which are relevant even at European level. The century-long cooperation between nature and the people living in it not only left a rich legacy here on a social, cultural or landscape level, but also made the survival of an extremely rich and diverse wildlife possible. It is not by chance that considerable populations of species of high nature conservation value even on a European scale can today be found in this region. Fifty-five percent of the Romanian Natura 2000 sites are located in Transylvania and twenty-four percent of Transylvania is covered by Natura 2000 sites. This particularly rich biodiversity is the result of a harmonious and balanced long-term coexistence between man and nature. It is the task of people living today to make sure that this legacy continues.

The Niraj -Târnava Mică region is one of those parts of Romania where the elements of traditional landscape structure and farming have remarkably survived. In the landscape made up of a delicate mosaic of deciduous forests, semi-natural grasslands, pastures, meadows, extensive orchards and ploughlands, the middle spotted woodpecker (*Dendrocopos medius*) and the corncrake (*Crex crex*) are still common. The lesser spotted eagle (*Aquila pomarina*) population of the area greatly contributes to

the fact that over one-fifth of the European population is made up of Romanian lesser spotted eagles. The brown bear (*Ursus arctos*), whilst being present in rather few regions on a Europe-wide level, remains common in this area, perhaps a bit too common if you ask some local people. And while it is still difficult to spot an otter (*Lutra lutra*), its traces can be regularly observed along the riverbanks. Despite the diversity of the landscape and species, invasive alien species, such as the ash-leaved maple (*Acer negundo*) or the cutleaf coneflower (*Rudbeckia laciniata*), Jerusalem artichoke (*Helianthus tuberosus*) and Canada goldenrod (*Solidago canadensis*), which give the landscape its yellow colour between August and October, are on the rise.

The spontaneous processes of the area (e.g. land concentration, urbanization, and land use change) are the consequences of external impacts on the local landscape and human community (e.g. globalization, technological development, EU subsidies). However, the local economy and the welfare of the local population is still very closely tied to the rich natural heritage. In addition, the natural environment may hold plenty of untapped potential for local development and economy which we can easily miss if we fully rely on the spontaneous processes. However, in order to recognize opportunities and avoid dangers, we need a deeper understanding of the cooperation between man and nature. The concept and research of ecosystem services provide an opportunity for achieving this understanding.

### 1.1.2 Project objectives

The aim of the project was to map and quantify the main ecosystem services in the Natura 2000 site of 91,000 hectares along the Târnava Mică and Niraj rivers. By adapting the latest European Mapping and Assessing Ecosystems and Ecosystem Services (MAES, Maes et al. 2014) methodologies to this traditionally managed hilly area of Transylvania, and by involving local stakeholders and residents in the process, the value and contribution of ecosystem services to main economic sectors (especially agriculture, forestry, tourism, angling and hunting) were assessed along with possible future changes to them. The project was designed to improve the knowledge of decision makers, stakeholders and the general public about the benefits of ecosystem services and the importance of maintaining them in a favourable condition.

Our specific objectives were:

- to map and assess ecosystems and their relevant services, as well as potential future changes to them within the project area;
- to analyse the integration of ecosystem service conservation in current national policies identifying solutions to stop the deterioration of ecosystems and their services and provide recommendations for policy development and implementation;
- to improve awareness of important local stakeholders (decision makers, land users, SMEs), of the contribution of ecosystem services to key economic sectors and of the importance of preserving them and
- to provide contributions to the European MAES process by acting as one of the first Romanian exemplars of a regional mapping and assessment procedure. The lessons learned from the Niraj-MAES project can significantly support the future national and EU-level implementation of Target 2/Action 5 of the EU Biodiversity Strategy (EC 2011).

With the project and its results, we aimed to reach the central government and related entities of Romania including the Ministry of Environment, Ministry of Agriculture and Rural Development,

Ministry of European Funds as well as agencies under the coordination of these institutions. We also targeted county-level stakeholders of Mureș, Harghita and Sibiu counties, including local authorities, academic institutions, NGOs of nature conservation and natural resource users (e.g. tourism associations or hunting-fishing associations), and the private sector (farmers associations, landowners and land administrators, including private forest districts, individual businesses).

An overview of the distinct research steps, their integration into the whole research and their linkages to the different chapters are shown in **Fig. 1.1**.

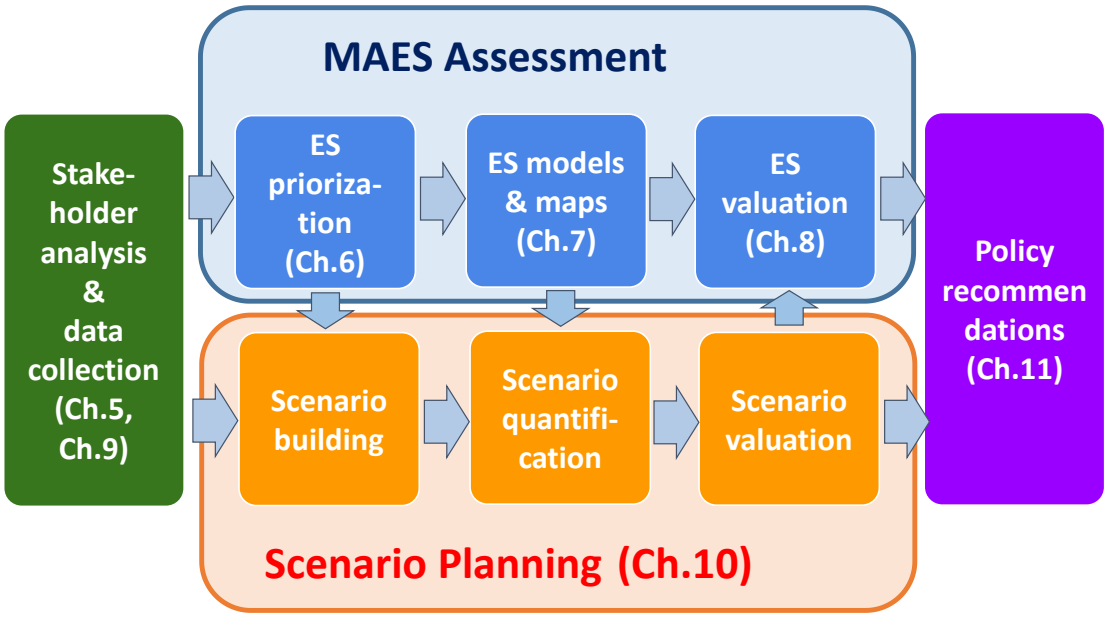


**Fig. 1.1:** The main workflow of the Niraj-MAES project. The two main research strands (*MAES assessment* and *Scenario planning*) are highlighted, and each project element is linked to the Chapter in which it is discussed.

## 1.2 The Ecosystem Services (ES) concept

Ecosystem services (ES) are the contributions of ecosystems to benefits used in economic and other human activity. The concept of ecosystem services strives to capture the multi-faceted relation of interdependence between ecological and socio-economic systems in a simplified way. To achieve this, it uses an analogy from the functioning of the economy: a provider (the ecological system) offers various services to a beneficiary (society). Vital services that natural and semi-natural ecosystems (e.g. forests, grasslands, marine communities) provide to society are commonly referred to as ecosystem services. The timber of forests, the self-purification of water bodies or the beauty of the landscape that is our natural habitat are all examples of ecosystem services.

### 1.2.1 Scientific background of the ES concept

The concept of ecosystem services broke into mainstream science after a long period of incubation in the early 2000s and has, since then, been taken into consideration in many important nature conservation policies on international and EU level. The development of the concept was driven by the recognition that one of the reasons of today's environmental crisis is the way society treats its specific problems in environment and natural resource management isolated. Thus, it can happen that while

society exploits a certain resource to the best of its ability, it generates unexpected shortages in others. To avoid this, science aimed to build new linkages between environmental fields in a synthetic way, hoping for a more coherent understanding of the ecological system and a more cooperative level of action. The main expectations from the new concept were eventually the better understanding and thus more efficient solving of the environmental challenges of the 21st century. The concept of ecosystem services and its practical application could represent a significant step towards realizing this expectation. It offers a common platform, a common denominator, and is able to translate the complicated processes and connections in nature to a simple language spoken by many.

ES are classified into specific categories defined by ecosystem service classification systems. There are a few such parallel systems existing is science, all of them distinguishing classes of provisioning, regulating and cultural services (**Fig. 1.2**). These three classes of services are indispensable for the healthy functioning of society and the economy, within that, local communities. Sometimes a fourth class called supporting services is also identified. In our research approach we consider supporting services as ecosystem processes not used directly by a beneficiary, as ecosystem conditions, which underpin those final ecosystem services which are used directly. Such processes are assessed by ecosystem condition indicators (see more at *Chapter 4.1*).


**Fig. 1.2:** The three main classes of ecosystem services.

### 1.2.2 International and European relevance of ES

The concept of ecosystem services became widely known after the publication of the Millennium Ecosystem Assessment in 2005. Since then, numerous important biodiversity conservation policies have advocated for it on both international and EU level, and a new intergovernmental body has been established to facilitate the policy integration of the concept (IPBES, Intergovernmental Platform on Biodiversity and Ecosystem Services).

The EU Biodiversity Strategy 2020 lays down the 'Mapping and assessment of ecosystems and their services' (MAES) and their integration into accounting schemes and decision-making processes as a concrete goal and responsibility of EU Member States. The Member States are supported by the

European Commission in their MAES process. The Commission has developed a coherent framework as well as a set of indicators to be applied by the EU and its Member States in order to ensure consistent approaches. MAES is a major tool which can link human societies and their well-being with the environment. Furthermore, determining ecosystem restoration frameworks, or building Green Infrastructure, which is another target of the EU Biodiversity Strategy, are not possible without determining the quantity, quality and value of ecosystem services. MAES is also a precondition to step up the EU's contribution to halting biodiversity loss globally as agreed under the EU Biodiversity Strategy Target 6 as well as the Global Strategic Plan for Biodiversity 2011-2020 of the Convention on Biodiversity (CBD).

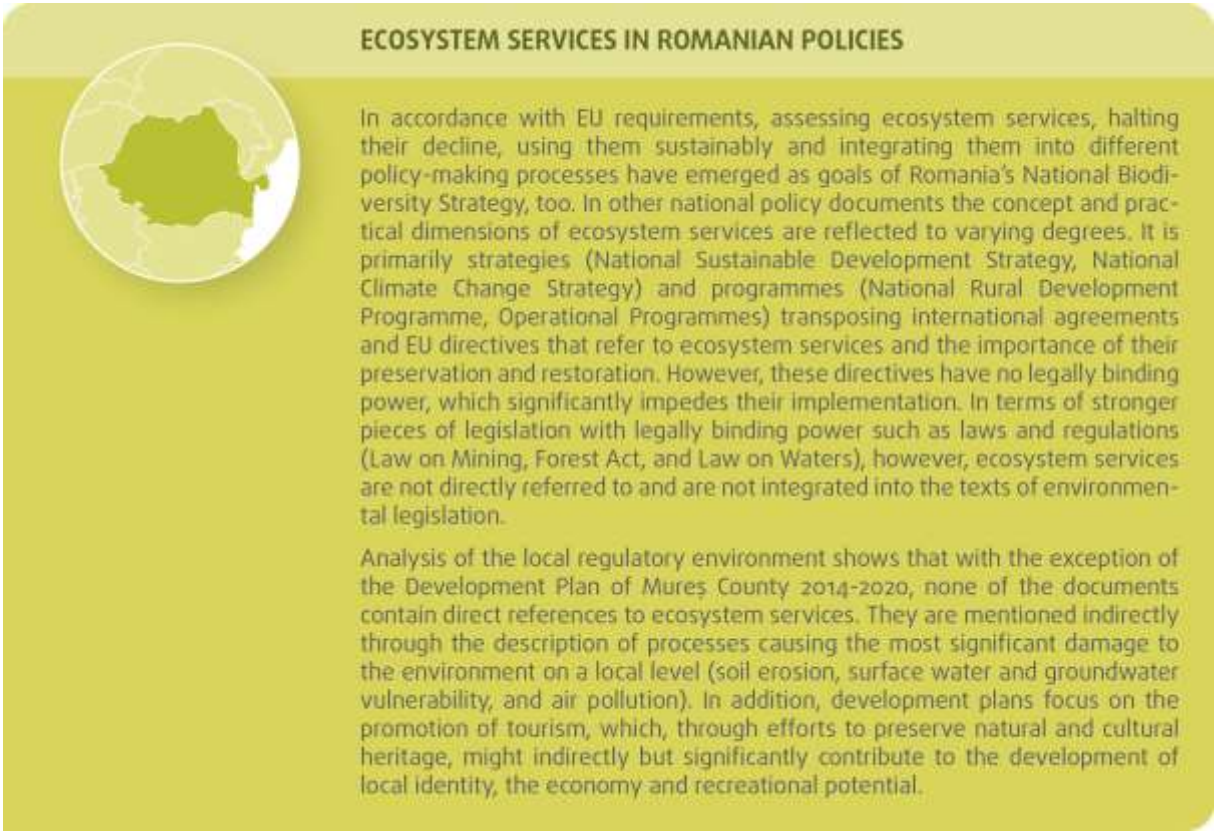


**Fig. 1.3:** Ecosystem services in Romanian policies.

This fundamentally determines the key directions of national biodiversity strategies of EU Member States, among them, Romania. However, for effective implementation the concept should be integrated into the goals and strategies of other sectors too, which is yet to be developed in most countries. The level of uptake of the ES concept in Romanian national policies is discussed in **Fig. 1.3** and in more detail in *Chapter 3*.

The EU's MAES process is very important for integrating ecosystem services into sectoral policies by highlighting the contribution of nature to economic sectors. It can, for example, help design rural development programmes under the CAP that best locate and optimise benefits for farmers, foresters and biodiversity. MAES also serves as an important tool to inform the development and implementation of policies and legislation in the field of water, climate, and regional planning as well as for the planning and implementation of EU funded projects. To achieve this, however, we need a uniform interpretation of ecosystem services, and it is also necessary to clarify survey methodology and make practical examples and guidelines available. There should also be a number of surveys and research available that juxtapose different ecosystem services. This is reflected in our research goal to

provide contributions to, and support the implementation of the European MAES process by completing a regional mapping and assessment procedure in a highly natural and traditional landscape. The lessons learned during this project have been channelled into the discussions of several EU platforms such as the MAES expert group of the European Commission as well as the international research project ESMERALDA (esmeralda-project.eu), which aims to assist Member States in their MAES implementation.

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# *2.* Characterizing the study area Niraj - Târnava Mică - people, landscape, vegetation

***Katalin Kelemen, Gábor Bóné, Márton A. Kelemen, Tamás Papp, Tibor Sós, Judith Papp***

## 2.1 General introduction of the site

The research area was designated to overlap with the four Natura 2000 sites around the Niraj - Târnava Mică region (**Table 2.1**). This was justified by the fact that the natural assets of the region are already well-known; the Milvus Group has been making surveys and various conservation activities in this area for over 20 years. The Natura 2000 sites of the study area thus cover land in three counties and 43 settlements, with the major part located in Mureș County, and two smaller areas in Harghita and Sibiu counties (**Fig. 2.1**).

Two rivers, the Niraj and Târnava Mică pass through the area, and the settlements are mostly located along them. 202 768 people (2014) live on 91 000 ha, with 13% of the population concentrated in the six cities of the region. Average population density is 68/km$^{2.}$. Since the political transition, the population has been continuously declining, due to three key reasons:

(1) declining birth rates,

(2) significant migration towards bigger cities,

(3) emigration in the hope of better life quality.

The population has been decreasing in 78% of the settlements, in some the decrease between 2011 and 2014 was 60%. However, we can take comfort from the fact that the proportion of the active population shows slight growth accompanied by a slight decrease in unemployment in the same period. While there are many agricultural areas in the country, official data show that few people earn a living in this sector. In addition to economic motivation (production of goods, self-sufficiency), preservation of traditions (“let the land be cultivated”) is also an important factor in land cultivation. In the Niraj valley 39% of the active population are employed in the industrial sector and 26% in the service sector. The Târnava Mică valley shows a different picture: 12% of the population receive their income from industrial activities and 18% from the service sector. Unfortunately, at present tourism is still in its infancy in the area, despite the great tourism potential of the region due to its natural and cultural assets. Only three settlements on the border of the research area are exceptions to this: Sovata, Praid, and Sighișoara - these attract great numbers of tourists. The rest of the area, however, has not been able to take advantage of these assets. The region is keen to profit from agricultural and rural tourism, but can offer no suitable touristic programs as of today. The infrastructure of the main natural and cultural attractions is poorly developed, hence they cannot be sold on the tourism market or if they can, only with difficulty.

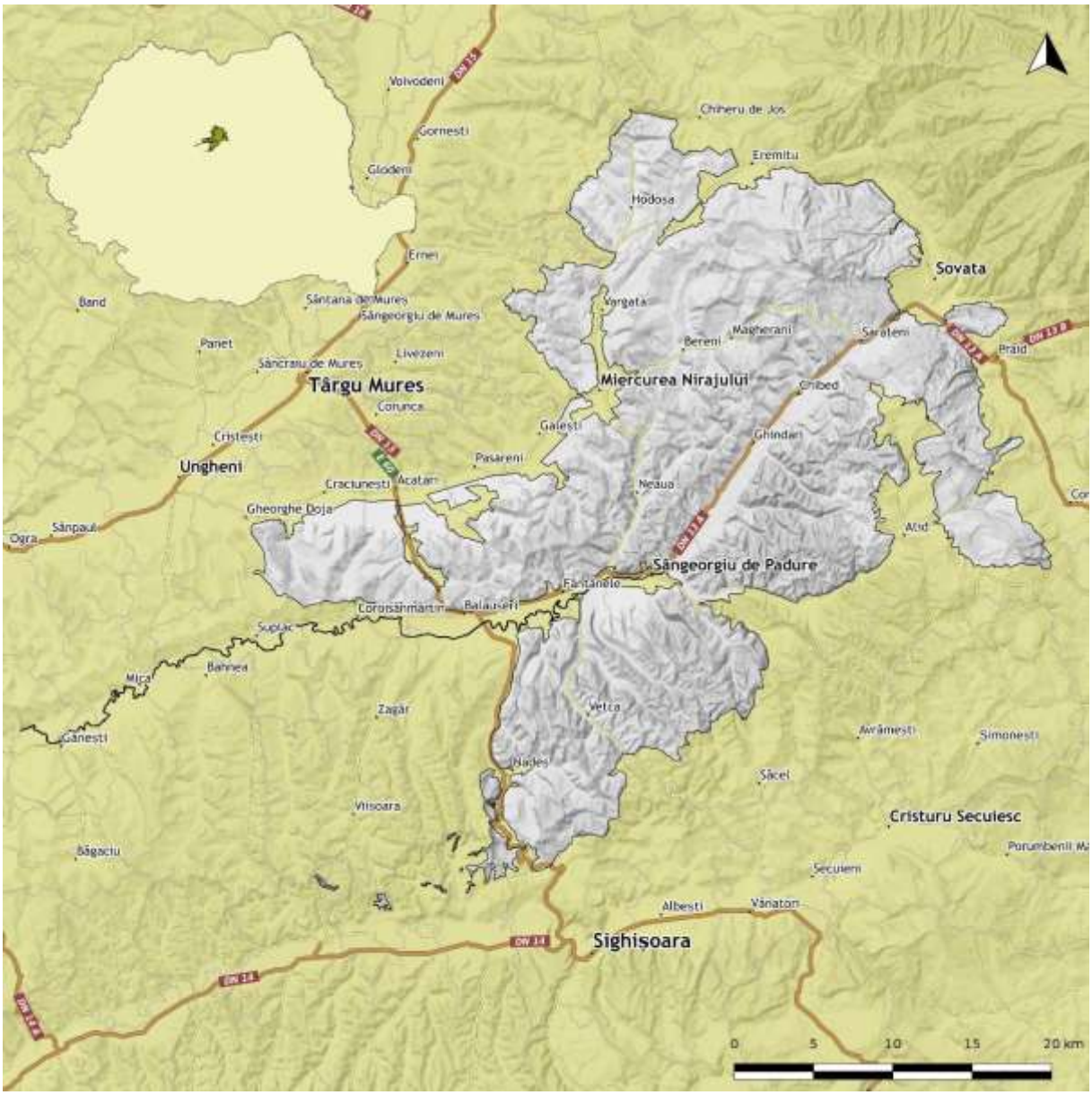


**Fig. 2.1:** The study area of the Niraj-MAES project: the Niraj - Târnava Mică region.

At present the region's land use still follows the pattern of traditional land use developed over centuries, adjusting to soil type and hillside exposure. Dominant elements of the lower-lying areas (200-600 m above sea level) are small plot ploughlands, meadows, pastures, orchards, and vineyards, as well as oak-hornbeam forests. In the higher-lying areas (500-600 m above sea level) there are more forests, but semi-natural meadows and pastures are also common. Agricultural areas and forests still follow traditional management, which also contributes to the persistence of mosaic nature of the land and biodiversity. In the past couple of years, land concentration has accelerated and in more and more places the small plots have been replaced with larger and intensively cultivated lands. The number of infrastructure investments has also increased. Summer houses and homes converted from provisional buildings (e.g. sheepfolds) linked to traditional land use are common. This change is especially pronounced in the regions that rivers formed more suitable for agricultural activity.

**Table 2.1:** The four Natura 2000 sites around the Niraj - Târnava Mică region.

| **Sites' surface and distribution by counties** | **Surface** (ha) | **Harghita County** | **Mureș County** | **Sibiu County** |
|---|---|---|---|---|
| SCI Dealurile Târnavei Mici – Bicheș *(Târnava Mică - Bicheș Hills)* | 37,082 | 13% | 87% | - |
| SCI Pădurile de stejar pufos de pe Târnava Mare *(The downy oak forests on Târnava Mare)* | 240 | - | 53% | 47% |
| SCI Râul Târnava Mică *(Târnava Mică River)* | 331 | - | 100% | - |
| SPA Dealurile Târnavelor-Valea Nirajului *(Târnave Hills and Niraj Valley)* | 86,073 | 13% | 87% | - |
| **Total area (ha)** | **91,308*** | **12,313** | **78,499** | **113** |
| **Percentage of total area by counties** | **-** | **13.5%** | **86.4%** | **0.1%** |

**the sites partially overlap*

## 2.2 Geographical features

The most important rivers that flow through the project area are the Târnava Mică and the Niraj rivers with numerous affluent streams, which form the hydrographical network in the zone. These two rivers deeply fragment this region, forming well-developed valleys, dividing Târnava Mică hills into asymmetric interfluves: interfluves between Târnava Mică and Târnava Mare, between Mureș and Târnava Mică and between Niraj and Mureș. The main hydrographic network (Niraj, Târnava Mică, Târnava Mare) is oriented generally from N-NE to S-SW.

Landforms of the protected area run between altitudes of 301 m and 1080 m (peak Bichiș, having maximum amplitude of 778 m).

Most slopes have average tilt tension (7.1 to 15°), representing 38% of the protected areas. On slopes with gradients of 2-3°, soil erosion is regularly occurring.

The greatest part of solar radiation is received by the right main slopes of Târnava Mică, Niraj Mic and Niraj Mare, and semi-sunny slopes of the tributaries. The southern and western exhibitions of slopes - especially along the main valleys - contribute, along with other factors, to the intensification of soil washing. The absence of woody vegetation cover, especially on slopes strongly inclined, not only explains the wide development of this process, but also the full range of current processes on slopes (Jakab 1977, Jakab & Makkai 1999, Jakab & Kovács 2006). Low grass vegetation on steep slopes diminishes only the intensity of this process, without preventing to reproduce.

The existence of the primarily natural Târnava Mică river with meandering galleries has favoured conservation of gallery forests with *Alnus glutinosa* and alluvial willows, which required site designation of ROSCI0384 Târnava Mică (Standard data form Natura 2000, 2011). While meanders have suffered serious human intervention only in the Bălăuşeri area, meander cuts were also made to Cuştelnic, Păucişoara and adjacent localities were created flood protection barrages.

Meanders of Niraj are reduced in size, although they are in an advanced stage of development. Given the high frequency of flooding on the Niraj river, several hydraulic works were executed including the reshaping, calibration and correction of the riverbed, consolidations of banks and building necessary ramparts from the land soil during the work. Because too many meanders vanished, the slope of the Niraj river increased excessively, leading to a strong erosion of the banks, for which they made several thresholds to reduce the slope and a series of works to strengthen the bank (Valeriu, 1994). It is noted that they have executed the channel of Veţca, which was intended to take over the debts of the left bank tributaries of the river Niraj between Miercurea Niraj and Cinta.

Landslides are one of the main features of the study area. The lithological composition of a sequence of clays, marls and sands, and the climatic conditions characterized by significant rainfall amounts provide favourable conditions for triggering these processes. This explains the prevalence of landslides in areas where marls predominate, in contrast to areas predominated by sands (Dumitreni - Veţca - Jacodu), where the frequency of landslides is low.

The deforestation of large areas of land is another factor that favoured the development of landslides, especially in the last period (17$^{th}$ century). Soils formed on marl and clay have a low infiltration coefficient of precipitation. Generally, these soils have poor erosion resistance.

In addition to natural factors (substrate lithology, slopes, landscape fragmentation, etc.) that facilitate the development of slope processes, the influence of human intervention in nature has an important role in shaping the landscape.

Human intervention shaping the relief was imposed also by intensive agricultural works: terracing, ploughing along the slope, overgrazing etc. Stabilized massive landslides were used not only for human settlements, but also to cultivate land by grubbing and drainage depressions of the waves sliding. Growing slopes contribute to a faster evolution by loosening the soil, which favours a more intensive washing of the material from the top of the slope and submitting it to the base.

The project area is located on the hills of the Transylvanian Depression, which provides a plateau landscape, fragmented by valleys which cross from South to North. In the centre there are rows of hills and on the verge of the mountains it has depression and corridor units formed. The specific landscape type is structurally represented by cuestas, petrography and bealii anticlines. Specific forms resulting from slope processes include landslides formed by the eruptions of the Vaneasa volcano, ravenal forms, and fluvial relief (terraces, meadows).

## 2.3 Climate

The climate is temperate, influenced by differences in altitude between the central and marginal parts of the region regarding the exposure to the movement of different air masses. The average annual temperature ranges between 6°C and 10°C and average annual rainfall is about 700 mm.

## 2.4 Vegetation

The area is characterized by the variety of different habitat types, creating a mosaic of forest vegetation, meadows, pastures and arable land. The higher hills from between the valleys of the Târnava Mică and Niraj rivers has been an inhabited land for a long time, and traditional farming had an important role in forming the actual landscape. Although in the past century the rivers were regulated and the habitats became fragmented by newly built roads, the natural and semi-natural habitats as a result of the traditional heritage of the region is still of an important conservation value.

The forest vegetation is usually concentrated at the top of the hills, and is composed of pedunculate oak (*Quercus robus*) – hornbeam (*Carpinus betulus*) forests, which in the higher regions make transition towards beech *(Fagus sylvatica*) forests. In the north-eastern side of the protected area, at the foot of the Eastern Carpathians, beech forests become dominant. The vegetation reflects the transitional character, these hills being located between the Transylvanian Highland and the mountainous region of the Eastern Carpathians. Montane elements infiltrate into the hay meadows dominated by common bent (*Agrostis capillaris*), red fescue (*Festuca rubra*), or golden oatgrass (*Trisetum flavescens*) in the gaps of the forests, such as silver thistle (*Carlina acaulis*) or fringed gentian (*Gentianopsis ciliata*). These grasslands are still used for cattle grazing and to a minor extent hay making. In lower sites false oatgrass (*Arrhenatherum elatius*) – dominated grasslands are still used as lowland hay meadows, and in the vicinity of the Niraj river traditionally mown great burnet (*Sanguisorba officinalis*) meadows host a series of rare plant species like daffodil (*Narcissus stellaris*), star gentian (*Gentiana cruciata*), snake's head (*Fritillaria meleagris*), siberian iris (*Iris sibirica*), or bistort (*Polygonum bistorta*).

The hillsides and sunny slopes, used as pastures for sheep, are covered by large semi-dry grasslands, dominated mostly by tor-grass (*Brachypodium pinnatum*) and furrowed fescue (Festuca rupicola). These grasslands, originating from clear cuttings of centuries ago, are representative examples for extensive and traditional management resulting in communities of high floristic diversity. In these grasslands we find a wide range of species, from those characteristic of forest-steppe meadows (betony (*Betonica officinalis*), St. Bernard's lily (*Anthericum ramosum*), greater knapweed (*Centaurea apiculata ssp. spinulosa*), white swallow-wort (*Vincetoxicum hirundinaria*) to the xerophile ones (common rock-rose *(Helianthemum nummularium*), horseheal *(Inula ensifolia*)). Many of them host several orchid species (green-winged orchid (*Orchis morio*), burnt-tip orchid (*Orchis ustulata*), military orchid (*Orchis militaris*), fragrant orchid (*Gymnadenia conopsea*), or even marsh helleborine (*Epipactis palustris*)), representing priority type habitats. On steep, south-facing slopes the herbaceous vegetation becomes open, with real steppic species (bridal veil (*Stipa capillata*), periwinkle (*Vinca herbacea*)). Further from villages (such as between Șilea Nirajului and Măgherani), one can find islands of forest-steppe meadows, which survived among the arable lands on little hill-cones. These islands host a surprisingly great floristic diversity, including white broom (*Chamaecytisus austriacus*), *Peucedanum sp., Ferulago sp*., blue-green moor grass (*Sesleria heufleriana*).

On the riversides, in less disturbed areas we can find little patches of willow (*Salix alba, Salix pentandra*) and alder (*Alnus glutinosa*) galleries, but these are present nowadays only as narrow bands. Unfortunately quick development compromises sometimes the natural heritage by building new roads and regulating the rivers, which at a moment leads to alarming distribution of invasive alien species, a rather frequent phenomenon along the valleys, road-, and riversides.

The greatest value of this landscape is the extensive land-use which resulted in a highly diverse landscape, and made possible the persistence of a great many species depending on traditional agriculture practices. In modern Europe, where the intensification of agriculture caused a severe decline in traditionally managed land, and many western countries struggle for reviving or substituting these practices, a landscape still based upon this lifestyle is of an outstanding value.

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# 3. Ecosystem Services within Romanian policies

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# Abbreviation List

**AEM** – Agri-environment Measures
**ANAR** – Romanian Agency for Water Management (Agentia Nationala a Apelor Romane)
**ANC** – Areas of Natural Constraint
**CAP** – Common Agricultural Policy
**CBD** – Convention on Biological Diversity
**CE** – Council of Europe
**CICES** – Common International Classification of Ecosystem Services
**DRBMP** – Danube River Basin Management Plans
**EEA** – European Environment Agency
**EIA** – Environmental Impact Assessment
**ES** – Ecosystem Service
**EU** – European Union
**EUR** – Euro
**GD** – Government Decision
**GDP** – Gross Domestic Product
**GO** – Government Ordinance
**GOV** – Government
**HNV** – High Nature Value
**MO** – Ministerial Ordinance
**MAES** – Mapping and Assessing Ecosystems and their Services
**MARD** – Ministry of Agriculture and Rural Development of Romania
**MEA** – Millenium Ecosystem Assessment
**MEF** – Ministry for European Funds
**MS** – Member State
**NBSAP** – National Biodiversity Strategy and Action Plan
**NGO** – Non-governmental Organisation
**NRDP** – National Rural Development Programme
**NSCC** – National Strategy on Climate Change
**NSDS** – National Strategy on Sustainable Development
**OP** – Operational Programme
**PA** – Priority Axis
**POIM** – Big Infrastructure OP (Programul Operational Infrastructura Mare)
**RON** – Romanian currency
**RBMP** – River Basin Management Plan
**SAC** – Special Areas of Conservation
**SCI** – Sites of Community Interest

**SDS** – (EU's) Sustainable Development Strategy
**TEEB** – The Economics of Ecosystems and Biodiversity
**TO** – Thematic Objective
**UK** – United Kingdom
**UNDP** – United Nations Development Programme
**UNEP** – United Nations Environment Programme
**UTCB** – Technical University of Civil Engineering (Universitatea Tehnica de Constructii Bucuresti)
**WFD** – Water Framework Directive

## 3.1 Mapping and assessing of ES in the European Union

According to Action 5 (Mapping and Assessment of Ecosystems and their Services, MAES) under Target 2 of the European Union's (EU) 2020 Biodiversity Strategy, by the end of 2014, Member States (MSs) should have mapped and assessed the state of ecosystems and their services in their territories (EU Commission 2011). If all runs according to schedule, by 2020 they will have further assessed the economic value of those services and integrated it into national and EU accounting and reporting systems. MAES is crucial to knowing the state of our natural capital, the trends related to it and the effects of our actions, including protection activities. This analysis will assess how much the current Romanian biodiversity and sectoral policies integrate ecosystem services considerations according to their status in 2015. The following main pieces of legislation are subjects of the analysis: the National Sustainable Development Strategy, the National Biodiversity Strategy and Action Plan, the National Rural Development Programme, the Law on Waters, the Forest Act, the Environmental Protection Law, the Birds and Habitats Directive transposition and implementation in Romania, the National Strategy on Climate Change, the Operational Programmes for 2014-2020 and the Law on Mining. At the end of each piece of legislation analysed, a summary of the Ecosystem Services mentioned or indirectly referred to will be conducted following the Common International Classification of Ecosystem Services (CICES).

### Ecosystem Services

Ecosystem Services (ES) are all those tangible and intangible benefits that natural or human-modified ecosystems provide and which are vital for human well-being. The topic of ecosystem services is becoming one of the most dynamic concepts among ecologists and conservationists. The concept is important in a scientific, a political, as well as in a practical point of view. Public awareness raising is a key objective, as the goal is that ecosystem services become quantifiable in order to integrate them into decision making processes concerning land use. Ecosystem services have been classified by several studies (Millennium Ecosystem Assessment 2005, The Economics of Ecosystems and Biodiversity (TEEB) 2010, Common International Classification of Ecosystem Services (CICES, Haines-Young & Potschin 2013) into three main categories as shown in **Fig. 3.1**.


**Fig. 3.1:** The three main classes of ecosystem services.

MEA concluded that 15 out of the 24 measured ecosystem services are in serious decline, only 4 are improving and 5 are stable but threatened in some parts of the globe. Loss of ecosystem services has powerful impacts on our economy and society, as it negatively impacts our economy, while economic poverty is often the main cause of resource overexploitation and unsustainable use of the environment. Loss of ecosystem services and degradation of natural capital further impoverishes disadvantaged societies. Economic inequality in turn reaffirms societal instability and dysfunction.

The National Sustainable Development Strategy (NSDS) is a joint document drafted by the Romanian Government and the United Nations Development Programme (UNDP) and approved in 2007 through the Government Decision (GD) 1216 on the 4th of October 2007. Its implementation falls under the jurisdiction of the Ministry for Environment, Water and Forestry and it is part of the obligation Romania took as an MS through the Lisbon Strategy and the 2006 EU Sustainable Development Strategy. NSDS provides three main development horizons for Romania, for 2013, 2020 and 2030, when the country should already be close to the average performance of EU MSs in that year (2030) in terms of sustainable development indicators. Nevertheless, although endorsed by the Government, the Strategy is not a legally binding document and it only lays down sectoral recommendations. This is perhaps one of the main reasons why the Strategy has so far not had any significant influence in the Romanian policy-making process. Therefore, the Strategy's overall implementation is lagging behind and progress might be made only by passing a legal act on sustainable development, establishing a clear action plan for implementation, allocating a budget and appointing responsible agencies with clear tasks.

The Strategy does, however, acknowledge the importance of ecosystem services (ES) (see **Table 3.1**) by referring to the European Union's Sustainable Development Strategy (SDS), whose overall objective is to improve management and avoid overexploitation of natural resources, recognising the value of ecosystem services (NSDS, p.57; EU Commission 2009). At the same time, NSDS highlights the implications of soil erosion in the Romanian farming production systems, where an estimated 150 million tonnes of topsoil are lost every year, of which 1.5 million tonnes are humus. This is manifested on roughly 2.5 million hectares, contributing in recent years to 10-20% of the arable land not being

cultivated (NSDS, p.23). Therefore, ES can play a crucial role here, by preventing soil erosion and making Romanian agriculture more resilient in the face of climate change, landslides or phosphorus and potassium deficiencies. ES provided by forests and green belts are particularly important, as they help to fix soil, prevent pollutant runoff in water courses and prevent landslides. It also offers protection against droughts through the creation of a more sheltered micro climate.

**Table 3.1:** ES directly or indirectly referred to in NSDS.

| ES category | ES |
|---|---|
| Provisioning | NSDS calls for a sustainable use of natural resources: biomass, water and abiotic materials |
| Regulating and Maintaining | • NSDS specifies in particular the benefit of ES in terms of soil formation and composition (fertility) and protection against weathering processes or decomposition and fixing processes.<br>• The Strategy also highlights benefits to i) water conditions; ii) soil formation and composition and iii) atmospheric composition and climate change from forests and green belts |

## 3.2 National Biodiversity Strategy and Action Plan

The National Biodiversity Strategy and Action Plan (NBSAP) for 2014-2020 was adopted in 2013 through the Government Decision 1081/2013 and lays down the ways in which Romania plans to achieve its international commitments agreed on at the Convention for Biological Diversity (CBD, 2015) and its European commitments related to the Birds and Habitats Directive as well as the 2020 EU Biodiversity Strategy. While it is not a legally binding document, the Strategy advances the budget requirements necessary for its implementation and estimated at RON 6.5 billion (roughly EUR 1.5 billion) for the 7 year period (see **Table 3.2**). Its implementation is under the jurisdiction of the Ministry of Environment, Water and Forestry and its subordinated public institutions, while the evaluation of progress in implementation is carried out by the Interministerial Committee for the Integration of Environmental Protection into the National Level Sectorial Strategies, established through the Government Decision 750/2005. Indeed, more progress has been made with NBSAP as opposed to NSDS: the former has a budget (although most of it is expected to come from external sources and is therefore subject to potentially significant shrinking) and a national authority as implementation body. Nevertheless, just like in the case of NSDS, little progress is recorded in the implementation of the Action plan, primarily because of the same reason: NBSAP is not legally binding so it is usually at the very bottom of national priorities.

In the NBSAP, the value of ES is mentioned in the first sections, in reference to TEEB assessment from 2008, which estimated the global annual loss of ES at EUR 50 billion. The study predicted an increase in financial deficit to 7% of the worldwide GDP by 2050, considering that the study's rough estimate of global ES valuation stands at USD 35 trillion, almost double than the global GDP (TEEB 2010). At the same time, NBSAP reminds that the current European policies do not account enough for ES, which cannot be preserved solely through biodiversity conservation. EU's initiative of Mapping and Assessing Ecosystem Services (MAES) is seen as a potential tool to solve this policy deficit (NBSAP, p.10).

NBSAP lays down the 9 main objectives for the implementation of EU's 2020 Biodiversity Strategy, of which Objective 8 is directed to the "maintenance of ecosystem services capacity to deliver goods and

services and function as life-support by: a) maintaining the support capacity of ecosystems and b) halting the loss of biological resources, traditional knowledge of local communities, techniques and practices which allow sustainable exploitation and food security" (NBSAP, p.11).

NBSAP acknowledges indirectly the significance of ES for delivering aesthetics by stressing the cultural and aesthetic role of European landscapes, which are the end result of human-nature interaction and indicators of human wellbeing and local identity (NBSAP, p.12). Moreover, section D of the document is the strategic objective of exploiting biological diversity components in a sustainable manner, which lays down 7 operational objectives to ensure the integration of biodiversity conservation priorities in sectoral politics and strategies. Objective 7 specifically aims to "increase the ecological function significance of land parcels, including riparian zones and those with alluvial vegetation, in order to mitigate soil erosion and preserve ecosystem functions" (NBSAP, p. 57). Likewise, within this strategic objective, Romanian authorities pledged the allocation of RON 4,300,000/year (approximately EUR 1 million) for evaluating and calculating the economic value for biodiversity components and ES within the priority objective of sustainable utilization of biodiversity components(NBSAP, p.100; see **Table 3.1**).

**Table 3.2:** Estimated annual budget for the implementation of NBSAP, budget lines indicated with * have only a partial estimation. Apart from state budget, the Romanian Government expects to cover the costs through the structural and cohesion funds, Fund for Environment, LIFE+ programmes and other external sources (source: NBSAP, p.125).

| Objective | Estimated annual budget (in RON) | of which State Budget (in RON) |
|---|---|---|
| Development of the general legal and institutional framework and ensuring financial resources | 22,900,000 | 1,900,000 |
| Ensuring coherence and efficient management for the national network of protected areas | 405,090,000 | 132,500,000 |
| Ensuring a favourable conservation status for protected wild species | 15,250,000 | 2,650,000 |
| Sustainable utilization of biodiversity components | 505,720,000* | 700,000 |
| Ex-situ conservation | 500,000 | 500,000 |
| Control of Invasive Alien Species | 1,230,000 | 550,000 |
| Access to genetic resources and the equitable share of benefits resulted from their use | 0 | 0 |
| Supporting and promoting traditional practices, innovations and knowledge | 0 | 0 |
| Development of scientific research and promoting technology transfer | 27,000,000 | 27,000,000 |
| Communication, education and awareness raising for the general public | 50,000* | 50,000 |

## 3.3 National Rural Development Programme

The National Rural Development Programme (NRDP) 2014-2020 was adopted in July 2014, representing the main policy instrument through which Romania implements the EU Common Agricultural Policy (CAP, see EU Commission 2015). The implementation of NRDP falls under the jurisdiction of the Ministry for Agriculture and Rural Development (MARD). The NRDP addresses a number of provisioning, regulating, and cultural ecosystem services through direct and indirect references, as shown in **Table 3.3**. In the ex-ante environmental impact evaluation of the Romanian NRDP, its potential impact on the functioning of ES is mentioned on a number of occasions. For instance, it is believed that without the implementation of the 2014-2020 NRDP, ES use would be inefficient (p.49) or that measures such as the provisioning of basic services including construction of sewage systems, road works or access to potable water and modernisation of villages will potentially pose a risk to the delivery of ES (p. 68). As long as they qualify for Environmental Impact Assessments (EIAs), new investments will be subject to this regulation, while other works which do not qualify for EIA will be subject to environmental protection assessment based on eligibility and other criteria.

The new NRDP is supposed to support ES by preserving biodiversity and the ecological integrity of High Nature Value (HNV) ecosystems, which are managed through traditional practices. It is estimated that 33% of Romania's territory is of HNV (Parrachini et al. 2008), which means around 78669 km2. The current NRDP targets 1,56 million hectares of HNV farmland, or roughly 20% of the total estimated HNV area in Romania (NRDP, p. 662-665). Also, NRDP will enhance conservation of several farmland specific species as well as that of forest species by reforesting areas where there is a forest deficit (p. 147) through measure 14 of priority axis 4.2. Furthermore, one of the thematic priorities of the Programme is to "preserve, restore and consolidate ecosystems dependent on agriculture and forestry" (p. 154) for which a total of RON 1.4 billion should be allocated by 2018. Main measures here will be Agri-Environmental Measures (AEMs, measure 10), payments for Areas under Natural Constraints (ANCs, measure 13). The estimated budget spending was calculated using the 2011 baseline of the previous NRDP and considering most applicants will apply for the new NRDP (NRDP, p. 165).

One of the strengths of rural areas in Romania identified in NRDP, is the "high share of agricultural and forested areas, which are generating ecosystem services, characterised by a high biodiversity, including significant areas of traditionally managed HNV farmlands contributing to biodiversity conservation" (NRDP, p. 73). The measure dedicated to payments for environmental forestry management has its selection criteria centred around the HNV areas and those areas, which ensure delivery of "critical ES directed at soil, water and biodiversity protection" (NRDP, p.452) – this is one in several HNV supporting measures directed to butterflies and birds protection, sustainable forestry and preservation of traditional agricultural practices.

However, some of the biodiversity and ES related measures from the last NRDP ultimately had a negative environmental effect. For instance, the measure on HNV grasslands gave the option of grazing or manual mowing for management of eligible land parcels. Because manual mowing is more labour intensive and more costly, it was easier for land owners to opt for grazing, a process that was largely unsupervised and led to overgrazing, harmful effects on pastures flora and at the same time posed soil erosion risks. Another example is linked to modernisation of agricultural holdings, which could have benefitted small scale family farmers and indirectly provide for the maintenance of HNV supporting farming systems. Nevertheless, due to the numerous eligibility criteria, this measure was only

accessible to medium to large farms, which had the required minimum economic size and the required amount of co-financing to apply for funds. In the end, the measure did not allow the adaptation and modernisation of HNV supporting farming systems, but provided incentives for medium to large farms to grow in size, thus encouraging more intensification and land consolidation. This latter phenomenon is also supported by small scale family farmers giving up some of all of their land because the farming business is not viable anymore – they usually sell their lands to bigger farms, who have the necessary resources to cultivate at a scale larger enough to obtain profit. Deeming that this trend has continued throughout the implementation of the last NRDP, there are hopes more support will be directed to small scale family farmers through the new rural programme.

**Table 3.3:** ES referred to directly or indirectly in the new NRDP.

| ES category | ES |
|---|---|
| Provision | • Nutrition: Biomass (Crops, livestock, animals from in-situ aquaculture)<br>• Materials: Biomass (Fibres and other materials from plants or animals for direct use or processing)<br>• Water: Water for irrigation<br>• Energy: biomass for energy |
| Regulation and Maintenance | • Soil formation and composition<br>• Gene pool protection (particularly for species related to agricultural habitats)<br>• Climate regulation and regulation of atmospheric composition by afforestation of agricultural lands |
| Cultural | • Intellectual and representative interactions (cultural heritage and aesthetics) through HNV landscapes |

## 3.4 Law on Waters

The Law on Waters is the main piece of legislation governing water management in Romania. It was first adopted in 1997 (Law 106/1997) then amended and completed through Law 310/2004, GO 3/2010 and Law 146/2010 for the transposition and implementation of the Water Framework Directive (WFD) and the Floods Directive. Its implementation lies within the jurisdiction of the Ministry for Environment, Waters and Forestry through the National Agency for Water Administration and in 2014 it had a budget of roughly RON 1.5 billion. An important change in the Romanian Law on Waters, first published in 1996 is the 2006 modification replacing in many cases the term “aquatic environment” with “aquatic ecosystems”. Nevertheless, the law does not specifically mention ES per se, although it does indirectly acknowledge services provided by ecosystems (see **Table 3.4**). Paragraph 6 of article 1 specifies the necessity to “the preservation, protection and improvement of the aquatic environment in the context of sustainable use of water resources are based on the precautionary principle, prevention, avoidance of damage at the source and the polluters pay principle and they must take into account the vulnerability of those ecosystems located in the Danube Delta and the Black Sea, as their balance is strongly influenced by the quality of interior waters that flow into them”.

Thus, the paragraph calls for a better quality of waters flowing into the Danube and the Black Sea, an area where some ES like water filtration can play an essential role. Another part of the Law on Waters

where ES can play an important role is the local schemes, as set in article 45. Local schemes are established for small river basins or parts of larger river basins and set the general objectives for the "valuation and qualitative and quantitative protection of water resources, of aquatic ecosystems and of wetlands", as well as general objectives on the "sustainable use and protection of all water categories from the respective territory" (article 45, paragraph 1). Paragraph 3 of the same article details that the evaluation of economic and financial means to carry out the necessary works and installations is done through local schemes.

Article 85 establishes that state budget will finance costs for aquatic ecosystem conservation (paragraph 2a), maintenance and repair for flood defences (paragraph 2b); while local budgets will finance costs for flood defences at a local levels, in compliance with existing regulations. Unfortunately, there is little experience in nature based solutions for water works and installations and hard engineering solutions are still perceived as the optimal method to protect the population against flooding. At the same time, there is little coordination and collaboration between the authority managing waters and water infrastructure, the one dealing with environmental protection and the one managing forests, although they are all under the same ministry. Moreover, a series of other water related works are carried out under the NRDP (e.g. modernisation of basic village facilities) or under the Big Infrastructure or Regional Development Operational Programmes (OPs), implementation for each belonging to a different ministry (MADR and the Ministry of Transports respectively). Finally, some points of the law, such as setting the hydrogeological protection perimeter, do not specify responsibilities, a timeline or sanctions, all of which should be clearly regulated and defined (UTCB, 2009).

**Table 3.4:** ES referred to directly or indirectly in the Law on Waters.

| **ES category** | **ES** |
|---|---|
| Provisioning | • Surface and groundwater for drinking and non-drinking purposes<br>• Energy: hydropower plants<br>• Biomass: plants, animals and algae from in-situ aquaculture or wild algae |
| Regulation and maintenance | • Filtration/Sequestration/Storage/Accumulation of waste, toxins and greenhouse gases (GHG)<br>• Maintenance of physical, chemical, biological conditions: chemical conditions of saltwater and freshwater bodies |

## Implementation of the Water Framework Directive

WFD is the Community's overarching legislation for achieving a good ecological and chemical status for all water bodies in the EU (EUR-lex, 2000). In practice, the main implementation tool of WFD is the River Basin Management Plan (RBMP), which set statutory objectives for water bodies and summarise the measures needed to achieve them. Because water is strongly linked to land processes, RBMP also inform decisions on land-use planning (UK GOV, 2014). In Romania there are 11 RBMP set through the Law on Waters, all part of the larger international Danube River Basin Management Plan (DRBMP). The goal of reaching good ecological and chemical status for Romanian water bodies by this year will not be reached. A 2012 assessment of the European Environmental Agency (EEA) found that more than 80% of Romania's transitional waters were in less than good ecological status, a situation similar to the country's lakes – although the MS performs much better for the chemical status, with most of

groundwater and rivers in good status (EEA, 2012). The same report identified diffuse pollution and hydromorphological alterations as the most critical issues. A good example to illustrate this is the Black Sea coast of Romania, intensively modified by anthropogenic works on infrastructure expansion, waterworks and urbanization, where more than 90% of the water is in bad ecological status (EEA, 2012). Although Romanian authorities acknowledge that the hard engineering techniques adopted for water works have had a negative impact on the country's waterways (ANAR, 2013), in practice these measures are still being implemented.

## 3.5 Forest Act

The Forest Act (or Forestry Code) was adopted in 2008 and recently modified in 2015. Its implementation is under the jurisdiction of the Ministry of Environment, Waters and Forestry through ROMSILVA, the Forestry Agency, which in 2014 had a budget of RON 1,5 billion, equivalent to that of the water management agency.

**Table 3.5:** ES referred to directly or indirectly in the Forest Act.

| ES category | ES |
|---|---|
| Provisioning services | • Biomass: crops, plants<br>• Energy: biomass for energy |
| Regulating and maintaining services | • Control or soil erosion rates<br>• Soil formation and composition<br>• Global climate regulation by reduction of GHG concentration<br>• Micro and regional climate regulation<br>• Mediation of flows |

The Code specifically highlights the definition of sustainable forestry management as the "administration and utilization of forests in a way that they maintain their biodiversity, productivity, regeneration capacity, vitality and health in a way that will ensure both at present and in the future, the capacity to exert multiple and permanent ecological, economic and social functions at a local, regional, national and global level without creating prejudices to other ecosystems". In this aspect, article 83 paragraph 1 stresses that having easier access to the national forests – so in other words being able to make use of their benefits - is a central factor in managing forests in a sustainable manner, as long as specific ecological requirements are kept for protected areas. While this practically calls for more human intervention, it can be a solid argument for integrating and preserving ES for the sake of sustainable development, through recreational, educational and ecotourism versus human activities harmful to the functioning of ES, such as deforestation. Article 88 is perhaps the part of the Forestry Code that best explains ES provided by forests (see **Table 3.5**). The article establishes the extension of Romanian forests' area as a national priority (paragraph 1) and reforestation as occurring on agricultural lands or areas outside the forestry fund, with the objectives of improving environmental conditions, improving the landscape, safeguarding and increasing agricultural harvest, preventing and mitigating soil erosion, protection of communication ways, dams or banks, protection of localities and of economic, social and strategic landmarks (paragraph 3). The Forestry Code envisages reforestation on 2 million hectares by 2030 (paragraph 3).

## 3.6 Laws on environmental protection

### 3.6.1 Government Ordinance on Environmental Protection

The Government Ordinance on Environmental Protection 195/2005 was adopted through law 265/2006 in 2006 and sets the legal basis for environmental protection in Romania. Its implementation lies with the Ministry of Environment, Waters and Forestry through the National Agency for Environmental Protection. The law specifies ecosystem functions in paragraph 3 of article 49, which deals with assessing the environmental impact of works affecting a protected area. In this perspective, optimal technical solutions must be found in order to keep the integrity of ecosystem functions. In terms of soil and subsoil protection, Romanian legislation is mostly dealing with prevention or mitigation of pollution and contamination and does not specify the potential role of ES in this area. This is the same with the law on air quality and prevention of air pollution, where accent is placed on thresholds, responsible bodies and public access to information, rather than ecosystem-based mitigation.

## 3.7 Birds and Habitats Directive

Romania has transposed the Nature Directives (EU Directive 92/43/CEE Birds and Habitats Directive, modified through Directives 97/62/CE, 2006/105/CE, 2013/17/UE and CE Regulation 1882/2003) through a number of laws and Governmental Ordinances which can be found in **Table 3.6** below. The main piece of legislation is undoubtedly the Governmental Ordinance (GO) 57/2007, lastly modified through law 73/2015. This piece of legislation aims to "guarantee the conservation and sustainable use of the natural inheritage, an objective of national interest and a fundamental component of the national sustainable development strategy" (article 1). The GO sets the rules of declaring protected areas, stipulating in article 8 (2) that proposals for the establishment of a protected area can be submitted by any natural person to the National Agency for Protected Areas. In terms of ES, the GO recognises the cultural value of some areas, as well as the touristic potential for protected areas in general. Specifically, the ordinance aims to protect particular geomorphological features through articles 8 and 41, therefore recognising the scientific, cultural and aesthetic value of such features.

**Table 3.6:** Existing (or under work) Romanian legislation for the transposition and implementation of the Birds and Habitats Directive (source: Ministry of Environment, Forests and Waters 2015).

| **Law/ Governmental Ordinance (GO)/ Ministerial Ordinance (MO)/ Governmental Decision (GD)** | **Directed to transposition (T) or implementation (I)** |
|---|---|
| GO 57/2007 on the status of protected areas, conservation of natural habitats, fauna and flora, modified through GO 154/2008, Law 329/2009. Adopted through Law 49/2011 and modified by Law 187/2012 and GO 20/2014, which was approved by Law 73/2015 | T |
| Law 407/2006 on hunting and the protection of hunting resources, modified and added to by Law 197/2007, modified by Law 215/2008, GO 154/2008, Law 80/2010, GO 102/2010, approved through Law 66/2011, modified by Law 187/2012 | T |

| | |
|---|---|
| GO 195/2005 on environmental protection, approved through Law 265/2006, modified by GO 57/2007, GO 114/2007, GO 164/2008, GO 71/2011 and GO 58/2012 | T |
| MO 207/2006 on the approval of the content of the standard Natura 2000 form and on the manual for filling out the form | I |
| MO 1964/2007 on the establishment of the natural protected area status for the natural sites of Community importance, as integral part of the European ecological network Natura 2000 in Romania, modified by MO 2387/2011 | T/I |
| MO 410/2008 approving the authorisation procedures for the sampling, capture and/or acquisition and/or commercialisation, on national territory or for export, of mine flowers, plant fossils, vertebrate and invertebrate animal fossils, as well as of plants and animals from the wild flora and fauna and of their import. Modified by MO 890/2009 | T/I |
| MO 979/2009 on the introduction of non-native species, interventions on invasive alien species, as well as the re-introduction of native species from annexes 4A and 4B of GO 57/2007 (see first row) | T/I |
| MO 19/2010 approving the methodological guide on the adequate evaluation of potential effects from plans and projects targeting protected areas of Community interest | T/I |
| GD 323/2010 on the establishment of a monitoring system for the accidental killing and capture of all bird species as well as of the strictly protected species from annexes 4A and 4B of GO 57/2007 (see first row) | I |
| MO of the Ministry of Environment and Ministry of Agriculture 203/14/2009 on the procedure of waiving protection measures for wild fauna and flora | I |
| MO 338/2013 approving some regulations for the sites of Community importance and/or natural protected areas of national interest | I |
| MO 1470/2013 approving the methodology for administration and custody ascription of natural protected areas, modified through MO 2438/2013, MO 2480/2013 and MO 2513/2013 | I |
| MO Project to add to MO 338/2013 (see two rows above) | I |
| GO Project to modify GO 57/2007 (see first row) | T |
| Law Project to approve GO 154/2008 (see first row) | T |
| GD 1284/2007 on the declaration of special protected areas for birds as an integral part of the European ecological network Natura 2000 in Romania, modified and added to by GD 971/2011 | T/I |

### Implementation of the Habitats and Birds Directive

According to Romania's article 17 report for the period 2007-2012, 17% of the country's territory is part of the Natura 2000 network. There are 383 Sites of Community Interest (SCIs) and Special Areas of Conservation (SACs), but only 4 of these – or 2% of the total – have at present comprehensive management plans. For 272 Natura 2000 sites, management plans are still under preparation (EU Commission 2013). 60% of the habitats are said to be in a favourable condition, compared to 20% of the species. In comparison, 67% of the species are reported as being in an unfavourable inadequate conservation status, while for habitats, this category is situated at 28%. Most well preserved habitats are the rocky habitats, grasslands, freshwater and coastal habitats. The least preserved habitats are bogs, mires and fens; dunes; and heaths and scrubs. On the other hand, fish, amphibians and reptiles are the least well preserved species, while more than 25% of the mammals and 40% of the vascular plants are in favourable conservation status (EU Commission 2013). The most pressing threats to habitats - and ecosystem services addressed within the legislation (see **Table 3.7**) - are agriculture, urbanisation, natural system modifications, and natural biotic and abiotic processes. The most frequent pressures are agriculture, mining, natural system modifications, and natural biotic and abiotic processes. A similar trend is observed for species, although as an addition here, urbanisation is both a major threat and a pressure (EU Commission 2013). Most measures taken to preserve habitats were related to spatial planning and forests and wooded habitats, while for species additional measures were related to agriculture and open habitats and wetland, freshwater and coastal habitats (EU Commission 2013).

**Table 3.7:** ES referred to directly or indirectly in the Nature and Environmental Protection legislation.

| ES category | ES |
|---|---|
| Provisioning | • Nutrition: biomass from wild plants, algae and animals<br>• Materials: biomass in the form of genetic material from all biota |
| Regulating and maintaining | • Mediation of waste, toxins, GHG<br>• Soil formation and composition<br>• Global and regional climate regulation |
| Cultural | • Physical and experiential interaction<br>• Intellectual and representative interactions: scientific, cultural, educational, aesthetic, entertainment |

## 3.8 National Strategy on Climate Change

The National Strategy on Climate Change (NSCC) was adopted in 2013 by the government and its implementation is the responsibility of the Ministry for Environment, Waters and Forestry. The Strategy outlines the objectives and the means through which Romania will fulfil its EU and international commitments in relation to tackling climate change. Evaluations on its implementation progress are planned in 2017 and 2019, while the strategy itself should be reviewed in 2015 and 2020. Nevertheless, the Strategy is not legally binding and does not have an estimated budget, which will make it difficult to implement.

There is good integration and acknowledgement of ES in the NSCC compared to the previously discussed documents (see **Table 3.8**). The aquatic ecosystems from forests are valued for their multiple environmental services, such as flood protection, water retention, contribution to ecological diversity and carbon sequestration (NSCC, p. 28). Likewise, the role of all ecosystem in carbon sequestration is mentioned again later in the strategy, where the harmful effects of their degradation are highlighted – in particular the risk of transforming ecosystems from carbon sinks to carbon emission sources. Also, investments in ecosystem conservation are seen as crucial for climate change adaptation and mitigation (NSCC, p. 67). Waste management is another factor regarded as a way to identify, quantify and evaluate ES in order to adopt optimal decisions regarding preservation, conservation and environmental management, as well as reducing greenhouse gas (GHG) emissions (NSCC, p.29).

**Table 3.8:** ES directly or indirectly referred to in NSCC.

| ES category | ES group/class |
|---|---|
| Regulating and maintaining | • Mediation of GHG by ecosystems: sequestration/accumulation/storage of GHG<br>• Atmospheric composition and climate regulation: global climate regulation by reduction of GHG and micro and regional climate regulation |

# 3.9 Other pieces of legislation and/ or implementation tools for legislation

## 3.9.1 Operational Programmes

There are 7 Operational Programmes (OPs) that Romania will implement for the 2014-2020 period, with funds managed through the Ministry for European Funds (MEF), as follows:

1. OP on Competitiveness
2. OP on Human Capital
3. OP on Big Infrastructure (Programul Operational Infrastructura Mare - POIM)
4. OP on Technical Assistance
5. OP on Regional Development
6. OP on Administrative Capacity
7. NRDP

Under its Priority Axis (PA) 1, the OP on Competitiveness supports research and development in the fields of bioeconomy and energy, environment and climatic changes. This includes sectors such as tourism and eco-tourism; energy and environmental management; and agriculture, fisheries and forestry, biopharmaceutics and biotechnologies. The total financing for this OP is of EUR 1,33 billion for the whole period, with Priority Axis 1 accounting for roughly EUR 800 million or 60% of the OP's budget.

POIM is one of the largest POs for Romania, with a budget of EUR 9,4 billion over the 7 years. The Thematic Objective (TO) 4 of the OP is directed to the promotion of sustainable transportation systems

and eliminating traffic blockages on major routes. TO 6 targets environmental protection and the promotion of sustainable resource use, while TO7 deals with promotion of climate change adaptation, risk management and prevention. Finally, TO8 aims to support transition towards a low carbon economy in all sectors. POIM has 9 PAs, of which the following refer to the environment and/or sustainable resource use:

- PA3: Developing a safe and environment friendly transportation system, with accent on reducing environmental impact
- PA4: Environmental protection and promotion of sustainable resource use. This is correlated with investments in water and wastewater management in order to comply with EU environmental requirements (Water Framework Directive, Birds and Habitats Directives) and investments in waste management.
- PA5: Biodiversity protection and conservation, decontamination of historically polluted sites and air quality monitoring
- PA6: Promotion of climate change adaptation, risk management and prevention. Emphasis here is on adaptation to effects of climatic changes, in particular droughts and floodings, with investments in dams and works on water courses. It also envisages investments to reduce erosion at the Black Sea, many of which are hard engineering, concrete-based solutions.

For PA5, both local authorities and NGOs are eligible for funding and responsible for implementation, depending on who is custodian of the targeted protected area. On the other hand, central authorities related to water management, risk management and meteorological warnings will be in charge of spending significant parts of PA4 and PA6. The Ministry for Transport will be responsible for the management and implementation of PA3, although recent years saw a great deal of criticism over the environmental impact assessments for roadworks.

PO on regional development, implemented through the Ministry of Regional Development and Public Administration, also incorporates TO6, in particular through urban development and (PA4) and PA5 on the conservation, protection and sustainable valuation of the cultural patrimony. PA4 has a 7 year budget of EUR 2,65 billion and supports investments in activities such as regeneration and revitalization of urban areas. PA5 has budget of EUR 300 million and allows central and local authorities, NGOs, religious entities and consortia to apply for funding with the aim of restoring, protection and valuing elements of cultural patrimony. PA7 is another important axis of the OP, dealing with diversification of local economies through developing sustainable tourism and allocating EUR 90 million in funding for local authorities and consortia.

### 3.9.2 Mining Law

The Mining Law 85/2003 was passed in 2003 and regulates mining activities on Romanian territory. As a matter of principle, mineral resources found under the surface are public goods and belong to the Romanian state (article 1). Mining activities are not allowed in protected areas (article 11(1)) unless there is a GD in this sense, adopted with the permit of competent authorities and stipulating compensations (article 11(2)). At the same time, the exploitation permit is given only after an Environmental Impact Assessment (EIA) is carried out and evaluated (article 20(1e)) and a plan to restore the environment is presented (article 20(1f)). Sand and gravel found in river valleys and riverbeds can be extracted only with permit from the water management authority (article 28(2)) and the same rules apply for alluvial gold recovery (article 30(1)). An exploitation permit can be withdrawn or suspended if the entity exploiting the resources has its environment permit suspended (article 33

(1c), article 34(1e)) or endangers the future utilization of mineral resources in the exploitation area (article 33 (1d)). The Mining Law also considers the importance of preserving provisioning ecosystem services related to mining activities (see **Table 3.9** below).

**Table 3.9:** ES directly or indirectly referred to in the Mining Law.

| ES category | ES group/class |
|---|---|
| Provisioning services | • Nutrition: surface and groundwater for drinking and non-drinking purposes<br>• Abiotic materials |

## 3.10 Conclusions

Ecosystem services are certainly an emerging concept and a lot of research is still needed for a more consolidated integration into the policy making process. Romanian legislation shows recognition to ESs, especially through the transposition of various international conventions (e.g. CBD) or European Directives (WFD, Habitats and Birds Directive) and strategies (Biodiversity Strategy, Sustainable Development Strategy). Nevertheless, most of the legal text bringing some recognition to ESs have to a large extent an advisory, guiding characteristic (for instance, all strategies). As previously mentioned, the strategies have no legally binding power and this aspect drastically hinders their implementation. Moreover, in most cases there is no budget allocated to implement the strategies (or where there is, most of the financing sources are uncertain), there are no clear responsible implementation bodies within the bureaucratic apparatus or where such bodies are mentioned, their tasks and responsibilities are missing. Consequently, while some of the strategies seem to be aligned to EU or international standards, in reality their implementation lags behind and the policy-making process they are supposed to guide is instead governed by a business-as-usual approach. On the other hand, when it comes to stronger pieces of legislation such as laws, the actual concept of ES is not completely integrated or understood and, more importantly, is not referred to directly or by using its terminology. Moreover, there are significant challenges in implementing the existing legislation and some legal parts with potential benefits to ESs are sometimes implemented in a way detrimental to them. For instance, some measures of the NRDP have had a negative effect on ecosystems and their functions and the same scenario can be met in the Law on Waters or the Forestry Code. Largely, this is due to a low awareness on what ESs are and which are their benefits and perhaps to the lack of scientific work and practical case studies in Romania, which would showcase the benefits of ES and enhance their integration in the decision making process.

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# 4. The Niraj-MAES research approach

***Ildikó Arany, Ágnes Kalóczkai, Ágnes Vári, Bálint Czúcz***

We planned a complex, interdisciplinary research process that combines methods of natural and social sciences and at the same time is able to join leading-edge research on the topic. The research process (**Fig. 4.3**) was built on two parallel strands that are interrelated on multiple points but substantially independent. These two strands comprise:

- a regional **ecosystem service assessment** (sensu stricto, **MAES assessment**) that fully follows the recommendations of the EU MAES working group (Maes et al. 2013, 2014), and thus complies with Romania's national obligations towards the 2020 Biodiversity Strategy (see *Chapter 3*); and
- a regional **scenario planning** study: a participatory social research process, which mobilizes the local population, and thus provides inputs and creates interest in the ES concept and the assessment process (Palomo et al. 2011).

We furthermore identified two high-level guiding principles, that helped us to organize and structure the research process, define key steps, and synthesize and communicate the results. These key principles include

- the **ES cascade** concept (see *Chapter 4.1*), that defines "entry points" for interpreting and "measuring" the flow of services from nature towards society, and
- the **participatory** approach(see *Chapter 4.2*) of priorities and elicitation of knowledge with appropriate social scientific methods, which creates a local "anchor" for the project, thus ensuring meaningful results and a better general uptake and policy integration at the most critical local/regional level.

Both guiding principles are relevant for both strands, though not to an equal degree: the cascade is more relevant for the *MAES assessment* strand (which is entirely organized according the structure of the cascade), and participation is more relevant for the *scenario planning* process (which is mainly justified by its efficiency in achieving a deeper involvement). However, there are many participatory elements in the MAES assessment, and we also resorted to the cascade (e.g. as a communication tool) several times during the scenario planning process. In the following parts of this chapter we will briefly introduce and explain both of these guiding principles, and then we conclude by describing the structure of the Niraj-MAES project.

## 4.1 The ES cascade concept

In order to be able to give a meaningful overview of ecosystem services, the flow of services from nature towards society (**Fig. 4.1**) needs to be thoroughly examined and understood. This process can best be described by the so called "cascade model", the starting point of which is the *condition of ecosystems* (level 1) that fundamentally determines their internal processes and operation (La Notte et al. 2015 based on Potschin and Haines-Young 2011). This condition enables ecosystems to provide services (*capacity*, level 2). However, the capacity of ecosystems to provide certain services is not the same as the services actually used (*actual use*, level 3) as the latter can be influenced by societal needs, "demand" at a given place and time, as well as the human inputs expended to obtain services. The

benefits of the services used then appear in the form of maintained or increased *well-being* in society (level 4).

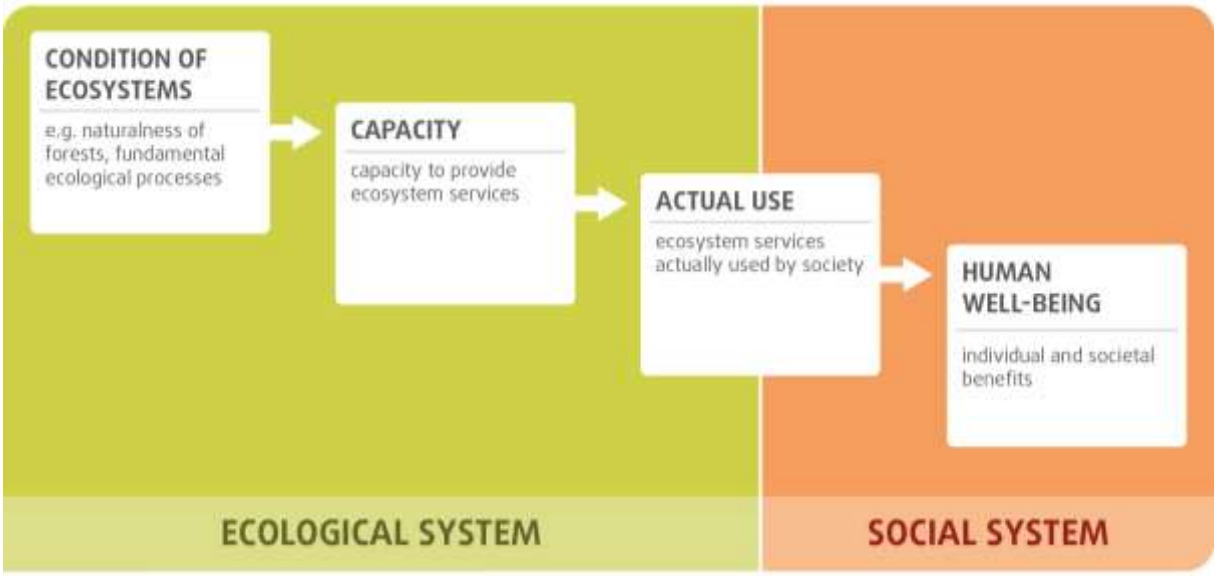


**Fig. 4.1:** The cascade model: the flow of ecosystem services from nature towards society.

However, the key steps of this pathway also provide a framework for assessing the services. Accordingly, we also attempted to trace the path of ecosystem services from nature to society along the components of the cascade model. We used distinct indicators and valuation techniques to describe the four cascade levels throughout the MAES assessment strand of this study:

- The indicators applied to assess the condition of ecosystems are called ecosystem condition indicators. Ecosystem condition indicators are not considered "services" in themselves; instead they describe characteristics of ecological systems that significantly impact the provision of several services simultaneously. Without the maintenance of good ecological status the preservation of services cannot be achieved. During our research we individually modeled and mapped the selected condition indicators (*Chapter 7*).
- We modeled and mapped the capacity of ecosystems to provide services for each service during the research (*Chapter 7*) and where possible, evaluated them by applying economic valuation methods (*Chapter 8*).
- We assessed the actual use of specific services by means of statistical data and questionnaire surveys using social and economic valuation methods (*Chapter 8*), while...
- …by the economic valuation of the actual uses we already estimated the contribution of ecosystems to one important dimension of human well-being (economic income, monetary wealth). However we also examined the non-monetary impacts of ecosystem services on human well-being, during the broad participatory prioritisation exercises of the project (*Chapter 6*, *Chapter 9*), as well as during the scenario development and evaluation process (*Chapter 10*).

To clarify the task, the concept of ecosystem services needs to be more clearly defined, too. In line with the definition presented in Chapter 1.1.2, tangible goods provided directly by the non-living physical environment (e.g. mineral salts, extracted drinking water) are not considered ecosystem services. While resembling ecosystem services in many respects they are created without the assistance of biota and are mostly excluded from investigations of ecosystem services in international

practice, too. Studies also exclude products derived from "industrial ecosystems" strongly transformed and controlled by man (e.g. crops from intensive agriculture) which require a vast amount of material and energy input from man (e.g. fertilizers, pesticides, agricultural machinery, fuel). These are regarded by the most widely-held approach as internal products of the economy to which natural ecosystems contribute only indirectly, through other services (e.g. ensuring pollination, natural plant protection, maintaining soil fertility).

## 4.2 Participatory approach

The use of scientific information for policy purposes should not be considered as a linear one-way knowledge transfer process. A better model for the relationship of science and society in this process is that of a "joint knowledge production" (Turnhout et al 2007). From a policy perspective, the success of a research project resides in the use of its results by policy actors, influence on policy processes, and impact on policy outcomes (Bauler 2012). It is actually the perception by key local, regional and national stakeholders (or policy actors) that determines the uptake of research results. There are three key components determining the success in this respect: credibility (=scientific and technical believability), salience (=ability to address user concerns), and legitimacy (=the political acceptability or perceived fairness of the process) (Eckley, 2001). In order to become influential, the research process needs to be perceived simultaneously and consensually as being legitimate, credible and salient by major groups of stakeholders (Bauler 2012). These criteria depend not only on the objective characteristics of the methods applied, but also on the perceptions of the relevant stakeholders. Accordingly, the research process should be considered as important as the results themselves, which is a common characteristic of postnormal science (Funtowicz & Ravetz 1993). Perceptions of credibility, salience, and, particularly, legitimacy can be ensured by thorough stakeholder involvement throughout the research process. Intensive stakeholder involvement can also be considered as an example of extended peer review proposed by Funtowicz and Ravetz (1996).

In this project we aimed at involving a broad variety of stakeholders throughout the entire research process. The two main roles of the stakeholders (sensu lato) were

- to help to define priorities (what is perceived as relevant, and what is negligeable from the perspective of the local population); and
- to assist in gaining a system understanding (knowledge elicitation, how the different components of the local socio-economic system are interlinked).

In the second case (knowledge elicitation), the participating stakeholders were mostly selected according to their expertise (local experts). The involvement of local experts enabled us to capture complex nature-society relationships in the form of simple, but (locally) relevant models.

As a key element of making the Niraj-MAES research approach participatory, we relied on the help from an "Advisory Board", comprising locals representing the most important economic and social sectors of the area (**Fig. 4.2**). The main task of the Board was professional supervision throughout the entire research process, thus ensuring credibility: every important step and result of the study was discussed with them and their suggestions were incorporated in the analyses, models and evaluations. Further major participatory events during the *MAES strand* of the project were the prioritization/non-monetary valuation of ES by general stakeholders (*Chapter 6*) and local business owners (*Chapter 9*), the creation of "matrix models" (*Chapter 7*), and the entire *scenario planning* strand of the project (*Chapter 10*).

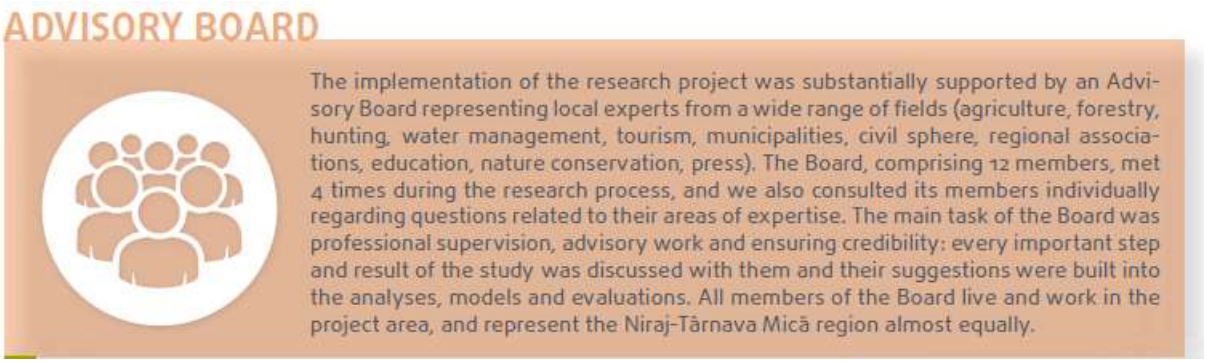


**Fig. 4.2:** The Advisory Board (AB).

## 4.3 The Niraj-MAES project structure within the chapters

The structure of the research project that we designed based on the guiding principles discussed above is presented in **Fig. 4.3**. The *MAES assessment* process predominantly follows the logic of the ES cascade, and the recommendations of the EU MAES working group, thus providing relevant results for high-level (regional, national and EU) policies. We supplemented this relatively fixed analysis with a *scenario planning* process with which we intended to address a wider group of the local community and thus give a more holistic and systematic analysis of services. The two strands of the study, *MAES assessment* and *scenario planning* clearly stand out as two distinct processes, which are, however, interlinked at a few key nodes to maximize synergies (discussed more in detail in *Chapter 10*).

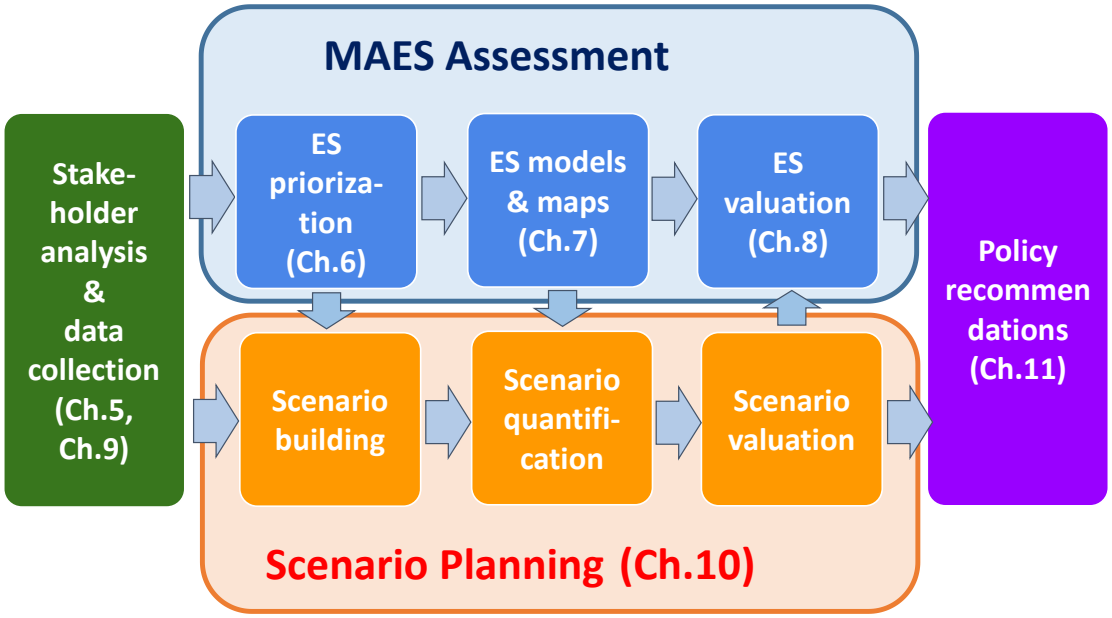


**Fig. 4.3:** The main workflow of the Niraj-MAES project. The two main research strands (*MAES assessment* and *scenario planning*) are highlighted, and each project element is linked to the Chapter in which it is discussed.

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# 5. Stakeholder analysis

***Ágnes Kalóczkai, Katalin Kelemen, Márton A. Kelemen, Imola Merza, Judith Papp, Eszter Kelemen***

This chapter summarizes the first steps of the participatory strand of the ecosystem service assessment project using sociological methods. We made interviews with the users and most important stakeholders of the Natura 2000 sites of the Niraj - Târnava Mică region to learn which ecosystem services they value the most, and what changes in the landscape they have noticed in the previous years or decades.

Besides investigating stakeholders, our study also compiles additional useful information brought forth during the data gathering, such as mentions of ecosystem services or social-economical changes.

We first introduce the methods applied for the data collection and basic properties of the research area. Next we briefly describe each stakeholder group and the relations between them, before presenting the actual results of the first phase in the ecosystem service assessment, the identified main socio-economical issues and possible rural development directions of local proposal.

## 5.1 Methods

The empirical data gathering was carried out with semi-structured interviews (Babbie 1995, Heltai & Tarjáni 2004, Héra & Ligeti 2005, Kvale 2005, Mason 2005). The interviews were made by the team members of the Milvus Group, who is the local partner of the project. The interview guideline contained the following key topics:

1. Introduction: Some personal questions about the interviewee and his/her professional background. These questions aimed to get to know the interviewee closer, to provide background data and start the interview

2. Local natural values and ecosystem services: these questions were created to explore the local natural and cultural values. They aimed to collect the ecosystem services that are the most important to the interviewee.

3. Changes of the natural environment: questions about the changes of landscape and land use. The aim of this group of questions was to explore what kind of changes (eg. transformation of forest management and agriculture, changes in the community, in the society, in the economy) and causes of changes are realised by the locals.

4. Closing the interview: questions about the future visions. It aimed to talk about the requirements and close the conversation.

Between 26 May and 31 August 2015 30 semi-structured interviews were made with farmers, hunters, beekeepers, forest managers, majors, colleagues of micro-region associations, local governments. Numbers of interviews were divided as follows:

- agriculture: 9
    - o farmers: 4
    - o commonage (ro: *composesorate*): 1
    - o beekeepers: 3
    - o agricultural expert: 1
- game management: 5

    - o senior expert: 1
    - o professional hunters: 4
- forest manager: 1
- education, community development: 3
    - o teacher: 1
    - o journalist: 1
    - o local historian: 1
- local governments: 6
- micro-region associations, non-governmental organisations: 4
- water association: 1
- parson: 1

In the selection of the interviewees we tried to cover a range of stakeholders and land users as wide as possible. The snowball method was used to get more and more interviewees (Babbie 2003, Patton 2002). The process of interviewing was continued until we got to the saturation point (Kvale 2005). The interviews were conducted anonymously.

Every interview was led by two interviewers. If the interviewee gave his/her permission, the conversations were recorded (3 interviews were not recorded because of the lack of permission). The average length of an interview was 1-1.5 hour. A written summary was made from every interview that collected the information mentioned during the conversation. If needed, interviewers made clarifications on the summary based on the recording.

The analysis was made by the social scientist of the MTA ÖK with simple qualitative content analysis (Mayring 2000, Forman and Darmschroder 2008): In the first step of the analysis, ecosystem services mentioned by the interviewers were collected. In the next step, the analyst identified the most frequently mentioned topics (such as the problems of agriculture, forest management, water management etc.) and summarized all of the information related to these themes.

**The next chapters present the thoughts, opinions, pieces of knowledge of interviewees - these might differ from reality.** However, our goal is to give a voice to the locals and present their views about life in the Niraj and Târnava Mică valleys as they see it.

## 5.2 Results of the interviews

### 5.2.1 The most important stakeholder groups and their relationships

In the following we define and describe shortly the most important land user groups of Niraj and Târnava Mică. At the end of the description a stakeholder map (Figure 5.1) visualizes the relationships between the groups.

*Farmers – (stakeholders of agriculture in a broad sense)*

This is a summary name of those who do livestock farming or produce crop. Most of the inhabitants of the research area are part of this group as almost every family have some lands, do some farming or

home gardening, grow vegetables or fruit for their own needs[1]. The majority of the locals have domestic animals. Farmers usually produce wheat, oat, corn and keep ship and some cattle on the pastures. As the amount of the animal subsidies will change soon (more money will be available for cattle keepers), a turn in the proportion of sheep and cattle is expected.

Farmers are connected with the APIA (*Agenţia de Plăţi şi Intervenţie pentru Agricultură*), the acquirers, and the land lessor. In case a farmer has forest and sells the wood, then he or she is connected with the logging companies.

*Land holders without land use activities*

Farmers who were active before but now retired are part of this group. They do not use their lands at all because of their age or bad health conditions. Many of them do not let out or sell their lands (because of emotional reasons) that contributes to the increase of land abandonment. Due to the abandonments invasive plant species were spread on the arable fields, and pastures started to became a bushy area.

Land holders without any agricultural background or who not live in the area are also part of this stakeholder group. They usually let out their lands. These land holders are in contact just with the lessee.

The subsidies of the European Union brought many transformations in the land use. Firstly, the amount of the abandoned lands started to decline in the last few years, as money that can be received for the land cultivation gave a motivation to the land owners/farmers. However, this opportunity has some negative impacts as well. According to the locals, some people bought lands just because of the subsidies, and they do not do any agricultural activities. They get other local farmers to cultivate their lands without official lease agreement. The 'invisible' farmer gets the harvest without any rental payments, the owner gets the subsidies. These owners are connected with the 'invisible' farmers and the APIA.

*Commonages* (ro: *composesorate*)

In the research area 11 commonages exist. Three leaders of commonages (Scaunul Mureșului - *Marosszék*, Eremitu - *Nyárádremete*, Hodoșa - *Hodos*) were interviewed. The commonage is a legal form of land ownership sharing that has a centuries-old history in Transylvania[2],[3]. The main advantage of this form of farming is that on the one hand it is easier to gain the agricultural subsidies, and on the other hand farmers have a stronger law and interest enforcement power. The Commonages mostly do pasture and forest management. Some commonage, such as the Scaunul Muresului Commonage has game hunting sector as well, so they are entitled to hunt on their area. Commonages are in contact

[1] ] Inhabitants who aimed to grow plants or keep animals solely for themselves are part of this group. Farmers, who have some farming land (size between a few are – a special Transylvanian area unit) besides their home garden are also part of this group. This latter group sometimes sell their home made products in the local markets or for the other members of the community. Inhabitants, who are actively engaged in farming are in this group

[2] http://erdely.ma/kisregio.php?id=110654HYPERLINK "http://erdely.ma/kisregio.php?id=110654&cim=kozbirtokossagi_vita_csokalyon_kie_a_legelo_az_erdo_meg_a_nadas"&HYPERLINK

[3]http://erdely.ma/kisregio.php?id=110654&cim=kozbirtokossagi_vita_csokalyon_kie_a_legelo_az_erdo_meg_a_nadas"cim=kozbirtokossagi_vita_csokalyon_kie_a_legelo_az_erdo_meg_a_nadas

with the APIA, the logging companies, the acquirers, the hunters, and other entitled hunter organisations.

*APIA: Agenţia de Plăţi şi Intervenţie pentru Agricultură*

This organisation belongs to the Ministry of Agriculture and Rural Development. Its main task is to manage the payment process of the agricultural subsidies and controlling. The organisation is in contact with the farmers, the leaders of the commonages and the landowners.

*Acquirers*

As local small-scale processing plants, slaughterhouses are not exist in the research area, farmers usually sell their raw products to acquirers. The biggest milk acquirer and processing plant is the Hochland and the Gabriella cheese factory. Usually the meat is bought up by foreign acquirers. Occasionally (for example before public holidays) the meat is bought up by the Petry company, the Dósa at Chibed (*Kibéd)* and the Fazekas Company at Târgu-Mureș (*Marosvásárhely*). The acquirers are in contact with the farmers, the commonage and the resellers.

*Foresters*

Forests in the research area are owned by private owners (individuals or commonage) and the Romanian State. The owners are obliged to apply a state forest expert or a private forest organisation who manage their forests (Mózes 2004). Owners also have to get a contract with the regional Directorate of Forestry. This latter specifies and controls the wood can be cut annually.

*State Forestry*

The state forests and those private forest, whose owner got contract with a state forestry, are managed by the Forestry Office. The management and the cutting is separated in the case of state forests, as the cutting is carried out by logging companies. The State Forestry is connected with the logging companies, the game managers, the wild edible fruit pickers, the Ministry of Environment, Water Management and Forestry (MMAP – Ministerul Mediului, Apelor si Padurilor).

*Private Foresters*

After the political regime changed in 1990 app. half of the forests went back again to the private owners. The legal framework of private forestry created in 2001. The private owners can use the forests for their own purposes or they sell the standing timber for logging companies. The private foresters are in contact with the logging companies and the game managers.

*Logging companies*

Logging companies are those organisations who contracts with the forest owners and have the right to cut the wood legally. These companies are often critiqued by the locals as it is said that they use unfavourable method of cutting. They make the cuttings in a rough way that causes damages in the forests and creeks, and destroy the roads. The companies are in contact with the state and private foresters.

*Game managers*

Game management was led by a national association and the forestry offices until 2010. After this year it became possible to found private hunting organisations. These organisations have to and are allowed to do the game management on their own hunting ground. A major part of their income is come from the guest hunters who pay money for the right of hunting. Therefore these organisations are interested

to keep the number of game in a high position and host as many guest hunter as they can serve. The other major part of the income is come from the membership fee.

The hunter organisations often get in conflicts with the farmers because of the agricultural damages caused by the games. According to the farmers the biggest problem is the process of the damage adjustment as it is too bureaucratic and complex and farmers do not get any help to the administration of the damages. Moreover, hunter organisations often try to take the advantage of this chaotic process and avoid the compensation of the damage. They are obliged to pay the compensation of the damage caused by defined games. Damages made by protected animals are compensated by the State. A hunter organisation is connected with the farmers (in the case of damages) and the guest hunters.

*Poachers*

Poachers must be differentiated from hunters as they do their activities illegally. They use traps and sometimes guns to hunt for game. Usually they hunt for their own consumes or because they want to decrease or prevent the agricultural damages made by the games. It is also occur that official hunters hunt illegally with not-permissioned gun. Poachers sell the trophies and meat illegally. They are only contact with these illegal consumers.

*Beekeepers*

The number of beekeepers in the last few years increased suddenly due to the subsidies introduced some years ago. The majority of beekeepers are travelling with the beehives to find better and better places for the bees. Two associations, called Niraj Beekeeper Association (*Asociația Apicultorilor de pe Valea Nirajului)* and Târnava Beekeeper Association *(Asociația Apicultorilor Târnava Mică),* represent the interests of beekeepers. The most important plants that give the best honey are oilseed rape, black locust (*Robinia*), wild flowers, linden (*Tilia*), fruit trees, sunflower, alfalfa, sainfoin (*Onobrychis*) and ratchet (*Lotus corniculatus*). According to the beekeepers the most valuable plant is the black locust. Beekeepers and farmers are in an interdependent situation. On the one hand, the bees are fundamentally important for farmers because of the pollination. On the other hand, the crops and other habitats maintained by the farmers are essential for the bees. Conflicts between these two stakeholder groups can emerge in case of chemical spraying that can be harmful for the bees. The beekeepers are in direct contact with the national or foreign honey acquirer companies and local consumers. The travelling beekeepers are in contact with the local governments as they have to get a permission before they fix the beehive.

*Directorate of Maros River basin (ro: Administrația Bazinală de Apă Mureș)*

Along the Niraj and Târnava Mică water managers follow the classical engineers' view as fast run-off of the creeks and rivers must be provided in order to prevent the flood damages. This requires to dredge out and control the river beds from time to time. Due to the dredging valuable wetlands and natural areas disappeared, bushes and trees along the creeks and rivers were cut. However, the flood risk was reduced, the natural nutrition supply declined. These changes are in opposite with the interests of nature conservationists and farmers and cause conflicts them.

Water managers are connected with the municipalities and the locals through formal administrative processes and public hearings. Water managers have a contact with the processing plants too, as processing plants can work legally if they get a permission from the water authority. The Directorate are also in a contact with the Natura 2000 Management Associate, the micro-regional associations and the environmental NGOs.

*Municipalities*

116 settlements (three cities and 32 administrative units comprising of several villages each) can be found in the research area. One of the main interests of the municipalities is to build up a strong cooperation between the settlements and achieve rural development purposes that can decrease the amount of unemployment and the migration of locals.

*Micro-regional associations*

Two micro-regional associations exist in the research area. The Niraj Mirco-Regional Association *(Asociația Microregiunea Valea Nirajului)* was founded in 2002 with the cooperation of 13 settlements. The Târnava Mică Micro-Regional Association (*Asociația Microregiunea Târnava Mică*) was founded by six municipalities and 27 individuals in 2001. The overall aim of these associations is to strengthen the cooperation between the civil organisations, the entrepreneur sector and the municipalities in order to encourage rural development initiations, increase the quality of life, develop the local health care services and build a cohesive community. The associations have an important role in strengthening the social network and the organized care of elderly, and they give a hand for farmers in the application of agricultural subsidies. The Niraj Micro-Regional Association participate actively in the administration of Natura 2000 areas. Their activities are mainly financed by the European Union and other projects. Micro-regional associations get in contact with all the other stakeholder groups but they mainly work with the local municipalities, the NGOs, the local entrepreneurs and the public institutions.

*Non-governmental organisations (NGOs)*

NGOs have a significant role in the community development, rural development and in the nature protection. They financed themselves by project money. They are in close relation with the micro-regional associations.

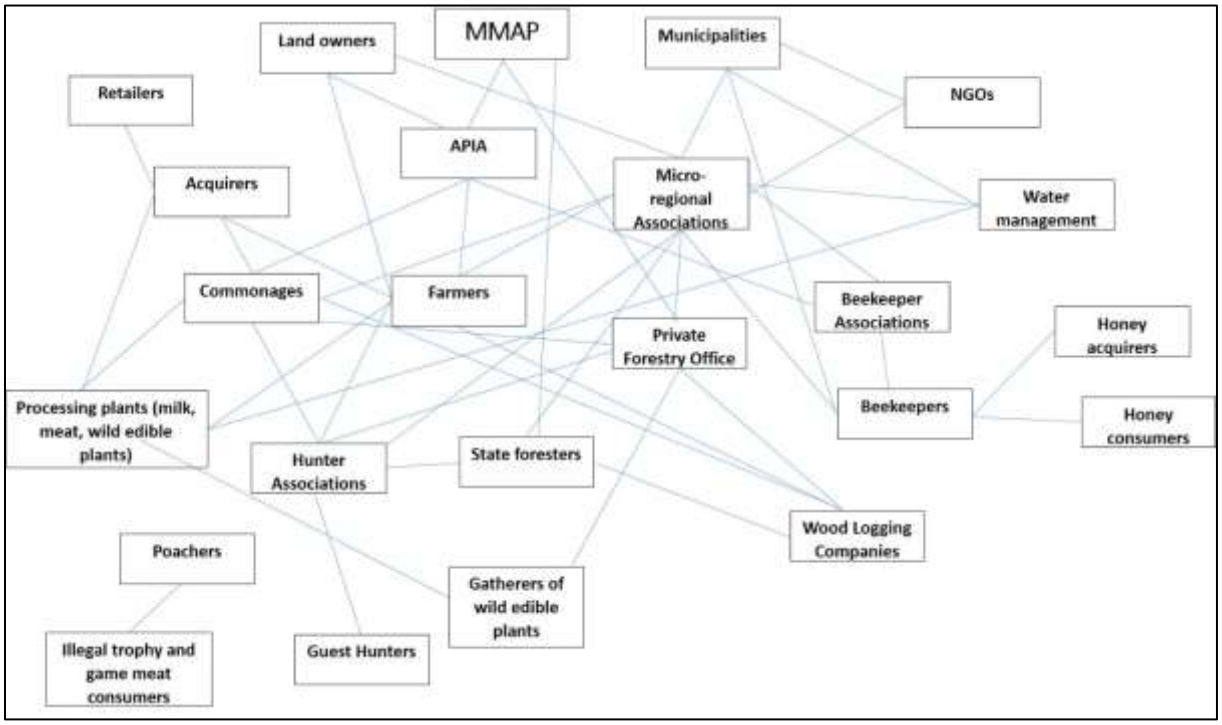


**Figure 5.1:** Stakeholder map.

### 5.2.2 Local perception of ecosystem services – the past and the present

Interviews with local people reflect the richness of ecosystem services provided by the Niraj – Târnava Mică landscape. Altogether 38 ES and benefits were uncovered by 30 interviews, all considered locally important in the past or in the present. These 38 can be broken into four main categories: provisioning services (12), cultural services (15), regulating services (8) and benefits (3). For ES classification this study takes the Common International Classification of Ecosystem Service (CICES, Haines-Young & Potschin 2013) as basis, a classification system widely used at EU level, but customizes it at a great level to better fit the local situation. CICES identifies three main categories of ES presented in **Fig. 5.2**.


**Fig. 5.2:** The three main classes of ecosystem services.

In the following section ESs identified by interviewees are presented following the above drafted structure. Lastly, some benefits mentioned by interviewees are also presented, despite not having direct connection to the underlying ecosystem functions, processes and structures that generate them. The reason for including these benefits in the study is that they are derived from local ES and contribute to local well-being at individual or societal level.

## Cultural services

- Capacity of ecosystems to provide recreation and opportunities for tourism
    - recreational hunting
      This ES was mentioned by 2 interviewees, one having a hunting license himself, driven by the motivation of being outdoors in fresh air and good company, the other reckoning hunting as good opportunity for tourism.
    - recreation provided by riverbanks
      Intact banks of local rivers, especially of the river Niraj, has been famous among locals for bathing at summertime, offering opportunities for social recreation.
    - birdwatching

The landscape hosts good birdwatching sites, offering opportunities for recreation and local income generation as an attraction for tourists.

- recreational fishing
  Offers physical and mental recreation and entertainment.
- nature photography
  The picturesque landscape with its diversity of plant and animal species is rich in photo subjects, offering also opportunities for local income generation as an attraction for tourists.
- recreation provided by solitary trees and clumps of trees
  Old shady trees are places of rest and relaxation for livestock and people alike, contributing to physical and mental wellbeing.
- living memories of traditional land use
  The landscape has preserved several traditional and eco-friendly land use types, having formed rich diversity of semi-natural habitats for centuries. Some of these traditions are still alive and offer touristic attraction.

- Intrinsic value of nature, spiritual, religious and symbolic identity
  - spiritual peace and serenity
    Listening to the wind blowing through the pines brings peace and serenity.
  - silence and calmness
    The silence and calmness of the landscape was mentioned by several interviewees, contributing to their mental and spiritual well-being.
  - existence of forests, grasslands and waters
    The existence of habitats typical for this landscape is appreciated and considered important by local people even if they don't derive any material benefit from them.
  - beauty of the landscape
    Aesthetic value mentioned by several interviewees, contributing to mental wellbeing.
  - diversity of species, including rare and protected plants and animals
    Intrinsic value of local species.
- Nature as subject of education and local knowledge
  - environmental education
    Local natural environment offers excellent subjects for education, however this capacity is mostly mentioned as an underused one. Besides organized education, nature teaches kids, by its existence, to live in harmony.
  - traditional knowledge
    It is mentioned mostly related to traditional agriculture techniques and medical herbs. Several local farmers still follow old management traditions and some has great knowledge of herbs.

## Provisioning services

- Nutrition
  - wild edible plants and animals: berries, mushrooms and snails
    Berries, fruits and mushrooms picked in the area were mentioned exceptionally often. An old tradition kept today mostly by the roma population, picking supplies own needs and roadside sales. Some types of berries are purchased by local food processing companies. Rarely, tourists pick mushrooms too. Mushrooms most frequently picked

are agaricus, Lepiota, pink-gilled mushroom, blewit, boletus, chanterelles, milk cap mushrooms and Russula. Berries and fruits most frequently picked are strawberries, blackberries, wild pears, rosehips, black thorn. Animals: snail.

- game meat
  Game represents material and existence value for the locals on one hand, agricultural damages on the other. Game meat supplies local needs and that of tourists, as a side benefit of hunting tourism.
- fish
  Typical service of waters though rarely mentioned. Fish supplies local needs and that of tourists, as a side benefit of fishing tourism. Fish stock has decreased recently, as stated by some interviewees.
- honey
  Beekeeping is famous among locals to supply their own needs and for selling.
- fodder (hay and grass) for livestock (converted to meat and dairy products)
  Extensive cattle and sheep keeping based on grazing and hay cutting are elements of traditional land use of the area, which has largely formed the landscape. The reason why fodder is discussed under the section 'nutrients' is that it is eventually converted into meat and dairy products. These final products are often regarded as ecosystem services themselves, however we decided to identify fodder as the service directly linked to the ecosystems and all later stage products are identified as goods and benefits originating from the production system. This way we avoid double counting of essentially the same service.

- Energy and fuel
  - Wood fuel
    Wood represents clear and direct material value in the perception of locals, as household heating is mostly fuelled by wood. There are also some negative associations with wood due to the illegal cutting getting more frequent and bigger scale, according to some interviewees.
- Raw materials
  - Timber
    Often mentioned as a service having direct monetary value and thus generating important source of local income, although local timber processing industries are said to be in recent decline. Timber is linked to a number of local crafts and traditions as well as local timber processing enterprises.
- Water
  - Well water for households
    Almost all households are equipped with wells, providing water for washing, irrigation, to supply domestic animals and, if in good quality, for drinking.
  - Water of rivers for agriculture and industry
    Local agriculture and industry extracts water from rivers, sometimes illegally.
  - Hot springs

Utilized primarily as touristic attraction.

- Springs

  Water provided by springs is crucial for livestock. Tourists and locals also drink spring water it occasionally. Drying of springs was mentioned as a problem.

  Biochemicals, remedies

- Medical herbs

  Wild herbs are picked to supply own needs in most cases, although some herbs are purchased by local herb processing companies. Herbs are used as tea for home remedies. Frequently used herbs are rosehip, nettle, milfoil, camomile, Plantago, Hippophae, centaury, Lycopodium, elder, black locust, lime tree, chicory, Pulmonaria.

## Regulating services

- Air quality maintenance
  - Forests provide biological filtration of air pollutants and supply of oxygen.
- Climate regulation
  - Forests and trees moderate micro climate and provide protection against wind storms.
  - Vegetation and soils sequester and store $CO_2$, thus contributing to climate regulation at global level.
- Water protection
  - mediation of waste

    Intensive agricultural techniques (fertilizers, pesticides, stalled livestock) result in increasing pollution pressure on soils and waters. Limits of natural remediation capacities have to be considered.

  - mediation of water flows

    Appropriate vegetation cover prevents downstream floods by capturing rainfall and moderating heavy flows.

- Soil protection
  - Erosion protection

    Vegetation cover, especially forests, protect fertile layers of soil against erosion.

  - Natural soil fertilization by rivers

    Intact rivers and small streams used to supply agricultural fields with fertile layers during their regular floods, contributing to better yields.

- Maintaining habitats and lifecycle of species
  - Maintaining biological and structural diversity of habitats

    High diversity of landscapes and occurrence of special habitats with high naturalness allow reproduction and gene pool protection of vast number of plant and animal species.

  - Pollination

    Wild bees and other insects as well as honey bees pollinate crops and wild plants, thus allowing their reproduction. Pollination is vital for agriculture.

### Benefits of the above services, contributing to human well-being

- Local identity

  Exceedingly high number of interviewees expressed their strong emotional bond towards the local landscape, highlighting features such as rivers, forests and traditional villages. This emotional connection was considered as the biggest gift of local nature by several of them.

- Safety

  Mentioned by three interviewees, the landscape, the view of mountains around together with the local community gives people a sense of safety from global problems.

- Feeling of freedom

  The nature at the Niraj - Târnava Mică region is calming.

- Cultural heritage and built environment

  Built environment is in harmony with local tradition, rich cultural heritage and the natural environment.

## 5.2.3 Agriculture

### Agriculture in the Niraj - Târnava Mică region from the 20th Century until today

Interviews with local residents from the Niraj - Târnava Mică region gave also the opportunity to learn about bygone agriculture. During the discussions it revealed, that farming was the basis of the livelihood of people living in the region. Almost all of the families owned smaller or larger lands, vegetable gardens, backyard livestock, which played an important role in their own food supply. Famous fruit grower villages were Vădaș (*Vadasd*), Ghinești (*Geges*), Sărățeni (*Sóvárad*), Chibed (*Kibéd*), Ghindari (*Makfalva*), Trei Sate (*Hármasfalu*), where plum, apple, walnut, peanut, pear, and cherry was produced and sold in Târgu-Mureș (*Marosvásárhely*) and Gheorgheni (*Gyergyó*). Sângeorgiu de Pădure (*Erdőszentgyörgy*) was renowned for its vineyards.

All these small farms were completely destroyed by the collectivization of the communism. The traditionally managed small-scale farms were replaced by intensive agriculture, which resulted in significant changes in landscape structure and in the lives of the residents as well. Most of the orchards, vineyards and pastures disappeared and were replaced by arable crop production. The landscape has been changed significantly, the diversity and the mosaic structure of the natural agricultural habitats decreased drastically. Land has been managed with intensive tools and with excessive use of chemicals and fertilizers.

Collectivization also affected negatively the lives of the communities: social inequalities sharpened, relations within the communities weakened.

After the end of communism, due to the unregulated system of collectivism and because of the privatization of the lands, locals didn't believe in community agriculture anymore, mutual trust disappeared. After the returning of the lands, a strong individualization was evolving and those who returned to agriculture were trying to rebuild their farms individually. Despite the fact that several community initiatives – e.g. regional associations - strive to maintain and develop local small-scale

farms, agriculture couldn't be stabilized again, according to the interviewed farmers. This effort was hitherto only enough to slow down the deterioration of agriculture.

After the uncertain conditions of communism and the regime change, the region's agriculture stepped into a transition time (from 1990 until 2007 - accession to the EU) when the small farms began to be revived. The returning of the lands began, whereby residents received their previously confiscated lands. As a result, today's mosaic landscape has been formed: before the collectivism, a family owned more than one parcel of land, scattered in the area, in order to decrease the effects of natural disasters (e.g. hail). However, without any livestock and tools, and under unsettled land tenures it was difficult to rebuild a farm, and those who moved to cities in the meantime, were not engaged in agriculture anymore and leased their lands or completely gave up on them.

A slow rearrangement was evolving among the farmer society. A group of small-scale farmers has been formed, who were slowly rebuilding their previously confiscated farms. Nowadays they are mostly engaged in traditional, extensive agriculture on an average of four hectares, and run a farm mostly for self-sufficiency.

Several commonages exist in the project area, which are the results of the pre-communism time. Today's commonages have been revived from these.

The region's commonages maintain only pasture and forestry activities and do not deal with arable crop production. The total areas have different sizes, the largest is the Scaunul Muresului Commonage, which manages a land on 8947 hectares. Commonages have higher chances in agricultural schemes, nevertheless, most people do not participate in these form of farming as it results in less work if the lands are leased.

The accession to the European Union means another new, significant era in agriculture. This developmental phase of agriculture seems to be unsettled according to the interviewees, and farmers also question the nature conservation regulations and economic benefits of the accession to the EU.

The accession to the EU in 2007 resulted in some changes but its positive effects are still doubted among farmers. On the other hand, many are optimistic as agriculture is still one of the most important sector in the region, not only because of economic, but also because of cultural reasons. Despite the drastic changes and ordeals in the past half century, people are still attached to the land and to farming due to cultural reasons. According to the interviewees, the majority of people are engaged in farming in some ways, and almost everybody does home gardening and many have still backyard livestock. Among others, Ghinești (*Geges*), Sânsimion (*Nyárádszentsimon*), Măgherani (*Nyárádmagyarós*), Rigmani (*Rigmány*), Vădaș (*Vadasd*), Neaua (*Havad*), Sângeorgiu de Pădure (*Erdőszentgyörgy*) and Chibed (*Kibéd*) settlements still have herds. On the arable fields mostly wheat, oat, triticale, sugar beet and corn is grown, although, the latter two are sowed constantly less due to game damage and lack of buyers. Except of some large-scale farmers, crop is mainly produced to feed own livestock. Grazing animal species have significantly changed in the latter years; cattle is progressively replaced with sheep due to several reasons: low market price of milk and the restricted possibilities to sell milk directly from the farm; i.e. it became unprofitable to keep cattle. On the other hand, support programs provide better conditions for keeping sheep, while environmental conditions would suit for cattle grazing.

Some interviewees also mentioned vegetable and flower growing, which are both present along the Niraj and the Târnava Mică rivers.

The once large fruit grower lands did not revive even after the change of regime. Main reason for this is that farmers lost their interest, as most of them had a knowledge in crop production or keeping livestock. On the other hand, lack of processing industry makes it unprofitable to deal with fruit production. Other problems are the difficulty to acquire the traditional species and to avoid game damage (which is in orchards mainly bear). In addition, there are only a few farmers with a great knowledge about traditional, extensive fruit production.

As a result of all the above mentioned, the farmer society and the landscape is in continuous transformation. On one hand, the abandonment of pastures and succession is still a problem on areas close to the settlements. These lands are owned by elder farmers who are not able cultivate their lands anymore due to health problems, but do not want to give up the land because of emotional reasons. On the other hand, another group of farmers evolved who's only focus is to meet the minimal requirements of agri-environmental programs but actually they are not active producers (e.g. they mow, but don't keep animals).

Another negative consequence of the abandonment of lands is the appearance and the spreading of invasive plant species, which is a threat to agriculture and for nature conservation as well.

The constantly rearranged agricultural system is strongly affected by economic and social circumstances, i.e. social circumstances also rearrange. One of the biggest fears of locals is that such a farmer society will evolve who have no interest in small-scale traditional farming and in maintaining the culture, who are not locals i.e. have no attachment to the land and whose only goal is to make economic profit.

## Agricultural issues mentioned in the interviews

According to the locals, agricultural subsidies should be more targeted for helping farmers keeping their lands. With the help of the agri-environmental programs the abandonment of lands seems to decrease, and some farms could utilize grants and seem to develop slowly. Nevertheless, according to the interviewees, small-scale farmers are not ready yet for exploiting the opportunities provided by the EU; moreover Romanian and EU background policy does not support a system in which grants can actually be received by families running a small-scale farm. Despite the fact that 70-80% of the locals are more or less engaged in agriculture, only those can apply to grants who work in a community (commonage); or bigger farmers who are able to apply independently (e.g. for machines). Another fear of the locals is that small-scale farms will be unable to function with the conditions of the current agricultural support system and with the current economic circumstances, they fear that their lands will be taken over by larger farms and as a consequence the mosaic feature of the landscape will be lost. Further criticism to the existing grants is that target areas are not well designated and that application requirements do not apply to local conditions. The current system is unable to filter out whether a land was only bought to win grants but actual or adequate farming is not implemented.

Further, the exploitation of the subsidies is difficult for small-scale farmers because regulation systems are not transparent, the constantly changing requirements are difficult to follow. However, regional associations, rural development- and community building associations can provide professional help regarding giving information about the applications and in writing the applications.

Production, selling and processing of agricultural products do not build an integral, closed system which further hinders farmers in development. The lack of processing factors, slaughterhouses and milk collectors result in the low price of the raw materials which are sold unprocessed. Another sales

problem considering livestock is that a group of farmers only keep beef cattle to feed them up but after reaching the weight of slaughter the animals end up in the same company from where they were bought as a calf.

The use of fertilizers and chemicals decreased compared to communism times, nevertheless its excessive use is still present in some areas which leads to the contamination of groundwater and water wells. Besides the intensive use of chemicals, the use of machines has also increased due to subsidies which is also a negative consequence of modernization. This not only strengthens the homogenization of the land but contributes to the weakening of farmer societies. Agricultural machines are mostly bought from grants, and as machines replace human workforce, there is no reason to ask for favours from each other anymore. Those who can not afford a machine, hire workers, thus the production costs will increase.

A serious consequence of intensive agriculture is the ploughing of the grasslands and transforming them into arable field. Although this activity is strictly forbidden, in many cases farmers don't know that they break rules with undertaking land use change.

## Forestry issues in the interviews

Because of its economic, cultural and social aspects, forests are considered to have a special value for people in the Niraj - Târnava Mică region. Forests provide food, timber, are the places of tradition, recreation, personal experiences, myth; they guarantee livelihood and provide job opportunities. All of the interviewees listed forests among the most important natural and cultural value.

According to our survey, forestry and forest management deteriorated. Logging with machines, taking advantage of timber sales, and illegal felling are serious problems. Logging is managed by certain companies. Illegal trading makes is easier to sell timber, but this way the seller not only gets a lower price for the timber but serious damages are caused to the forests. Because of the logging with machines the undergrowth and the bark of the remaining trees are damaged, the paths become impassable. Forest stream beds and banks are damaged, water is contaminated. Illegal logging is a significant problem on areas with an unsettled land tenure, on areas without forest management plans, and on areas which are not forest cultivations but the forest is a result of succession.

Interviewees agreed that the increasing bear damages are a consequence of deforestation. The animals are exposed to constant disturbance, their habitat and feeding areas decrease. As a result, they show up more often in inhabited areas.

Forest disturbance occurs also seasonally by gatherers. Mostly gipsy population collects berries, mushrooms, herbs, snails for their own consumption and for selling them. According to the non-gipsy population, besides the disturbance, a problem is the trash that they leave behind. The forest fruits gathered by people are bought by regional processing factories.

Interviewees expressed their concern that forest use and forestry becomes more and more unsustainable. They say that stricter regulations need be made immediately against forest destruction, and awareness raising is also a need in order to form the mentality of people.

## Game management issues in the interviews

Game management and hunting is one of the most important nature based activities in the Niraj - Târnava Mică region. The population and the number of game species in the area is quite rich. Except of the chamois, every game specie occurring in Romania is present on the area. Among others, these

are the red deer, roe deer, wild boar, bear, wolf, lynx, and among the small game species the capercaillie, pheasant, rabbit, partridge and quail.

12 hunting associates operate on our research area. Some commonages own also a game management sector besides the agricultural sector.

According to the interviewees, local game management faces some serious problems. Some of these are regulation or economic problems, as well as conflicts of interest. One of the biggest conflicts are the game damages (mostly bear and wild boar). The interviewees state, that the damages occur more frequently, as the habitats of the animals decreases. The population of the wild boar is artificially too high, which derives in our opinion from the management of game, in which sector the interest is the over-propagation of the game. The artificially high population of game is an interest of hunters associations as it generates significant income.

Population size of the bear is a topic accompanied by many debates. In the opinion of the locals, the number of the bears increased in the past 4-5 years. Bears not only damage orchards, but devour poultry and swine from the yards. Locals are concerned about the presence of the bears in the villages.

There is not enough information about the overpopulation of the bears and its optimal number in the area, according to one of the main concerned nature conservation organization. The currently used national yearly population estimation is questionable, and we have insufficient information about the species' biological and ecological needs. Thus, it is hard to tell when the population can be claimed as overpopulated. According to conservationists, damages caused by bears are seasonal: most of the damages are caused between July and November, and the scale of the damage also increases in this period. It was noticed, that the damages caused by bears are in line with the species' ecological characteristics, most importantly, with Hyperphagia (increasing feeding demand for a successful hibernation with the approaching of winter time). In those years, when oak- and beech acorns, forest fruits, wild pear, etc. grow in large quantities, damages caused by bears decrease appreciably. Consequently, safety and avoidance of humans is still a priority for bears. As a result, it cannot be stated that bears lost their fear of humans (except of some extreme cases, in the case of the so called habituated bears). Nevertheless, it is obvious, that forest fruit collection and grazing in the forest means a direct competition for the bears, and it is a significant disturbance factor (in "poorer" years these effects are more significant). It is possible, that these factors contribute to the increasing volume of the damages. In lack of natural, undisturbed opportunities to find food, the necessity of feeding overcomes the bears' fear. However, in the past few years, the media presence of the "bear problem" became higher (real, or sometimes misunderstood stories are broadcasted), thus the sensibility of the population has also increased.

According to hunter associates, game population problems derive from central management. In order to solve it, an increased involvement of hunter authorities in local decision making is necessary. Hunter associates yearly declare their demand on shooting quota based on their own calculations, but in most cases the government gives only permission for a small proportion of these requested numbers.

The problem is with the structure of compensation for damages caused by game species. According to the farmers, the process is complicated and long, thus many don't even start the compensation process. According to the regulations of game damages, the state is obligated to compensate damages caused by protected species. Damages caused by other game species are to be compensated by the relevant hunting association in cases if the association did not fulfil their obligation to meet the national frame shooting quota. It happens, that the farmer declares the game damage as a wild boar

or a deer damage in cooperation with the hunter association to spare the budget of the hunting association.

In overall it can be said, that the way of game management strongly affects farmers and the well-being of locals, as well as nature conservation. The regulation and situation of game management went through many positive changes compared to the time before the game management law in 1996, but the sector still struggles with a lot of regulation problems and conflicts of interests.

## Water management issues in the interviews

Water has a particular importance among locals in the Niraj - Târnava Mică region. Water was mentioned many times during the interviews, proving its significance. Citizens were especially sensitized to activities and changes related to waters. The high sensitivity of the people could be explained with the strongly controversial water regulations taken place also when the interviews were made.

According to the locals, the quality and quantity of waters is affected by two main factors. The first one is the water management, which is considered as "unnecessary" among locals. As a consequence, cultural possibilities lessen, habitats disappear, the functional role of streams and rivers change, and it has a negative effect on the view of the village and landscape. Although, sudden floods caused serious damages before, mostly settlements at the downstream of the river were affected. However, today's smaller floods are considered as a consequence of the excessive deforestation and not as a consequence of lack of water regulation. A reservoir established at Bezidu Nou *(Bözödújfalu)* serves today as flood prevention.

According to water professionals an appropriate water management can be recognized from an organized, clean (free from vegetation) river bed and river bank. The engineers believe a regulated river bed is the condition of flood mitigation.

Various reasons, such as intensification of agriculture, the excessive deforestation damaging mountain streams, and the behaviour of people in general result in qualitative and quantitative deterioration of waters.

Consequently, water regulation and water contamination topics have a high priority among locals. Residents clearly agree that waters on the area should be treated with much more respect, in addition, water quality and quantity problems should be addressed respectively to local needs.

## Socio-economic problems and breakout opportunities

Besides the discussions of the issues related to land use, the interviews gave also the opportunity to assess the local social and economic situation and development possibilities.

Results of the interviews show, that the local economic sector is considered as weak. According to the interviewed persons, apart from one or two exceptions, smaller factories, investors, processing industries which could provide job opportunities do not exist in the area. (Exceptions are bigger cities, e.g. Târgu-Mureș *(Marosvásárhely)*). Although the exodus of young people from the countryside is still significant, locals would not welcome foreign investors. They are afraid of utilitarian behaviours which could cause the degradation of the values on the land and an increasing contamination. Locals are attached to their lands and heritages and would not welcome foreign hands getting on the lands.

The majority thinks the solution for the economic problems would be the development of small enterprises and agriculture. Concerning the companies, those should be supported that consume local

resources in a sustainable way (small-scale processing industries, local consumption of forestry raw materials.)

Concerning the agriculture, small-scale farmers should be supported. This could be achieved most efficiently with the rearrangement of the agricultural support programs. Several of the interviewees stressed out the richness of natural (protected species, diverse wildlife, diverse landscape, streams, rivers, lakes, etc.) and cultural (castles, chapels, churches, museums, activities related traditional farming and to village life) values in the region, and added that they see a potential in the development of the tourism sector.

Locals see the necessity for developing local infrastructure, meaning the development of the quality and quantity of small restaurants, establishment of nature trails, renovation and establishment of public spaces (community centre) and building of drinking wells and lavatories.

In order to start all of the above mentioned, a renewal of local communities is necessary. Social relations weakened, which contributes to hinder joint development. Community initiatives (e.g. regional- and cultural associations) that strive for the development of communities and rural areas are present in the area, nevertheless, the existence of these communities depends on the success of constant application for grants and on the active work to keep the community together.

## 5.3 Conclusion

Based on 30 semi-structured interviews that we made with the region's main land users and other resident stakeholders, we concluded that nature provides a prominent number of ecosystem services (47) to locals. Especially high amount of provisioning services were revealed (27), which are primarily associated with material benefits. Local residents' attraction to nature and sense of local identity are also represented by the remarkable set of cultural ecosystem services captured in the interviews (15). Of the regulating services, five have been mentioned.

In addition to ecosystem services assessment, the interviews were also appropriate for deriving the landscape management issues most important to local people. Our study discussed these topics as well. First the current state of agriculture was described according to locals' points of view, which revealed that farmer, hence land use and landscape structure all undergo continuous changes. Agricultural subsidies take a growing role in farmholds' lives, in the exploitation of which larger ones have advantage in contrast to smallholder farmers who are harder to cope with its administrative requirements. The farmer community is aging out. Agriculture is ever less popular among the youth, who rather look for a job in cities or abroad than remain in the country. Partially due to the latter issue, landhold concentration has become characteristic, ecologically causing a less rich landscape mosaic.

Concerning grazing livestock the amount of sheep has increased, although the region would be more appropriate for the herding of cattle. The reason of the increase is again has to do with the subsidy institutions. The stock of dairy and extensive cattle heavily decreased in the last years because of unfavourable trends in the market price of milk. Thanks to adjustments in subsidy programs meanwhile, the rise of cattle population is expectable in the near future.

Forestry and wildlife management are also among the most frequently mentioned land use topics. Current trends in forestry triggered our interviewees to express their concerns over the ever less careful practices of lumbering and growing rate of deforestation. Regarding wildlife management they complained about overpopulation and game damage.

Concerning local water management most of the interviewees agreed that river regulation has significantly damaged the landscape and the rivers' cultural and ecological functionality.

To improve the current situation interviewees see the need for community and workfare development, also to keep youth in the area. They regard it necessary to targetedly support smallholder farmers and establishment of local manufacturing industries. They see numerous, yet unexploited opportunities in touristic development based on natural and cultural values.

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# 6. Selection of research priorities

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The selection of ES and the methods / indicators to measure them was done in an iterative decision context. In order to make the ES assessment locally as relevant as possible, research priorities were selected based on a preference assessment carried out in the project area. A broad range of local people were asked to rank an initial ES list derived from targeted interviews. The observed preferences' list was than revised based on conceptual and technical considerations, and with additional input from the Advisory Board.

The output of the work described in this chapter was the final list of ES to be further investigated (mapped and economically valued) during the Niraj-MAES project. There were several major factors that we had to take into consideration during this complex decision making process:

A. The preference of the local stakeholders: the results of the preference assessment are directly considered as a limiting factor in the decision process, while the tool of assessing preferences is also used to understand local perceptions and relations of different groups to ES in depths.

B. The "predefined" list of ecosystem services which was given in the original project proposal.

C. Conceptual considerations based on the cascade framework and MAES / CICES recommendations, determining the best position of an issue with respect to the assessment framework (e.g. if a topic is best mapped as an ES or an ecosystem condition indicator).

D. Data and methodological limitations: even if an ES or ecosystem condition aspect is generally considered as relevant, we cannot include it into the Niraj-MAES assessment if there are no data sources or methods available.

The most important criterion is (A). *Chapter 6.1* describes in detail the iterative preference assessment process that we used to solicit the opinions of a broad range of local stakeholders. All further criteria (B-D) are taken into account in *Chapter 6.2*, where we introduce and justify our final list of ES which fed into the mapping and assessment work shown in Chapters 7-9.

## 6.1 Assessment of local preferences on ES

A preference assessment survey was carried out in August 2015 to understand local inhabitants' and visitors' perceptions of ecosystem services (ES) and to prioritize them according to how respondents perceive the importance of ES in the local context. The results are important sources of information to the next steps of the research project: priority ecosystem services identified by the survey will be investigated in-depth through and indicator development process; and participatory scenarios for potential future land use alternatives will also build on priority ecosystem services (taken into account bundles and trade-offs among them). On the other hand, the preference assessment survey built on previous research activities, especially on the key informant interviews and on the regular interactions with the project's Stakeholder Advisory Board (SAB) consisting of experts and stakeholder representatives from the research area.

### 6.1.1 Background and methodology

As a first step, semi-structured **interviews** (total number: 30) with key local informants were carried out between June and August 2015 to collect information on how different stakeholder groups perceived nature and its benefits, and to shed light on the large variety of ecosystem services realized by them. The qualitative analysis of interview transcriptions highlighted a total number of 47 different ecosystem services which were grouped into the major groups of provisioning, regulating and cultural services (see *Chapter 5* for the detailed results of the interview analysis).

Next we organized an interactive group discussion to present this all encompassing list to the SAB members, who were asked to reorganize the list (i.e. reduce redundancy and sort out the locally irrelevant services) and define those 10-14 services which should be assessed during the preference assessment. This moderated group discussion resulted in a consensual list of 12 ecosystem services (edible wild plants, climate regulation, timber, water regulation, extensive orchards, game and hunting, tourism, soil fertility, pollination and honey, hay and grass, erosion control, local identity), which were then defined in lay language and illustrated by photographs taken in the research area. Based on these pictures and definitions a photo-panel (**Fig. 6.1**) was developed which we used as a visual aid to ask respondents to **prioritize** the five most important ecosystem services provided by various ecosystems within the research area.


**Fig. 6.1:** Photo-panel as a visual aid to support the choice of the top five ecosystem services of the research area.

The preference assessment survey followed a visual methodology where respondents were asked to review the photographs illustrating locally relevant ecosystem services and to choose the most important ones from the panel (for a more detailed description of the methodology see eg. Kelemen et al 2015; Kelemen et al. 2014, García-Llorente 2012). After each choice respondents were asked to justify why they thought that certain ecosystem service was of importance to them, which allowed us to collect qualitative information on what made different services valuable to local people (what are the relevant value dimensions in this specific context). Respondents were also asked if any relevant ecosystem services were missing from the panel to ensure that the priority list of ecosystem services was inclusive. The second part of the survey collected **general demographic** and **socio-economic data** as well as some additional information on having any specific stake or interest in ecosystem management (i.e. if and how respondents were involved in agriculture or tourism and whether they took part in the activities of any non-governmental organization having an environmental orientation). This information was used to analyse which individual characteristics influenced respondents' preferences and whether there were any common patterns of preferences across different groups of respondents.

Data was collected by 28 undergraduate students through face-to-face discussions with respondents. Students participated in a half-day online training organized a priori to the field work by researchers of the MTA ÖK and ESSRG Ltd.. During the training they were informed about the whole project and the main goals of the survey, and they received detailed methodological information (including the step-by-step explanation of the questionnaire). In the field students were coordinated by two[MP1] colleagues from the Association Milvus Group. They worked in pairs: one of them held the photo panel while the other one asked the questions and noted the answers. Seven pairs worked in settlements along the river Niraj, and another seven pairs worked along the river Târnava for three days. Since data collection was scheduled to a weekend when there was a local festivity, student pairs initiated discussions with respondents while walking on the streets of settlements belonging to the research area. No specific rules for sampling were followed, student pairs were asked to contact anybody (regardless of age, gender or any other demographic characteristics) and to do as many interviews as possible. Due to this practical approach to sampling, respondents are not representative of the entire research area in terms of age, school degree or occupation, but represent the two parts of the research area in approximately equal numbers. Due to the relatively large sample size, the error of margin is below 6% for the whole sample. To further increase the reliability of results, we prepared the priority list of ES for the main subpopulation of the sample (i.e. respondents dealing with farming, respondents below the age of 25). Beyond data collection students were also involved in recording the data in an excel sheet, which was cleaned and analysed later by researchers.

### 6.1.2 General information about the respondents

A total number 310 questionnaires were filled during the field work. Women and men answered the questionnaire almost in equal proportion (50.9% and 47.4% respectively). In five cases respondents gave answer as a group and not personally (1.7% of the whole sample) – in these situations answers were recorded as 'group answers' and personal data (e.g. age, occupation etc.) were not asked by the responding group (**Fig. 6.2 a**).

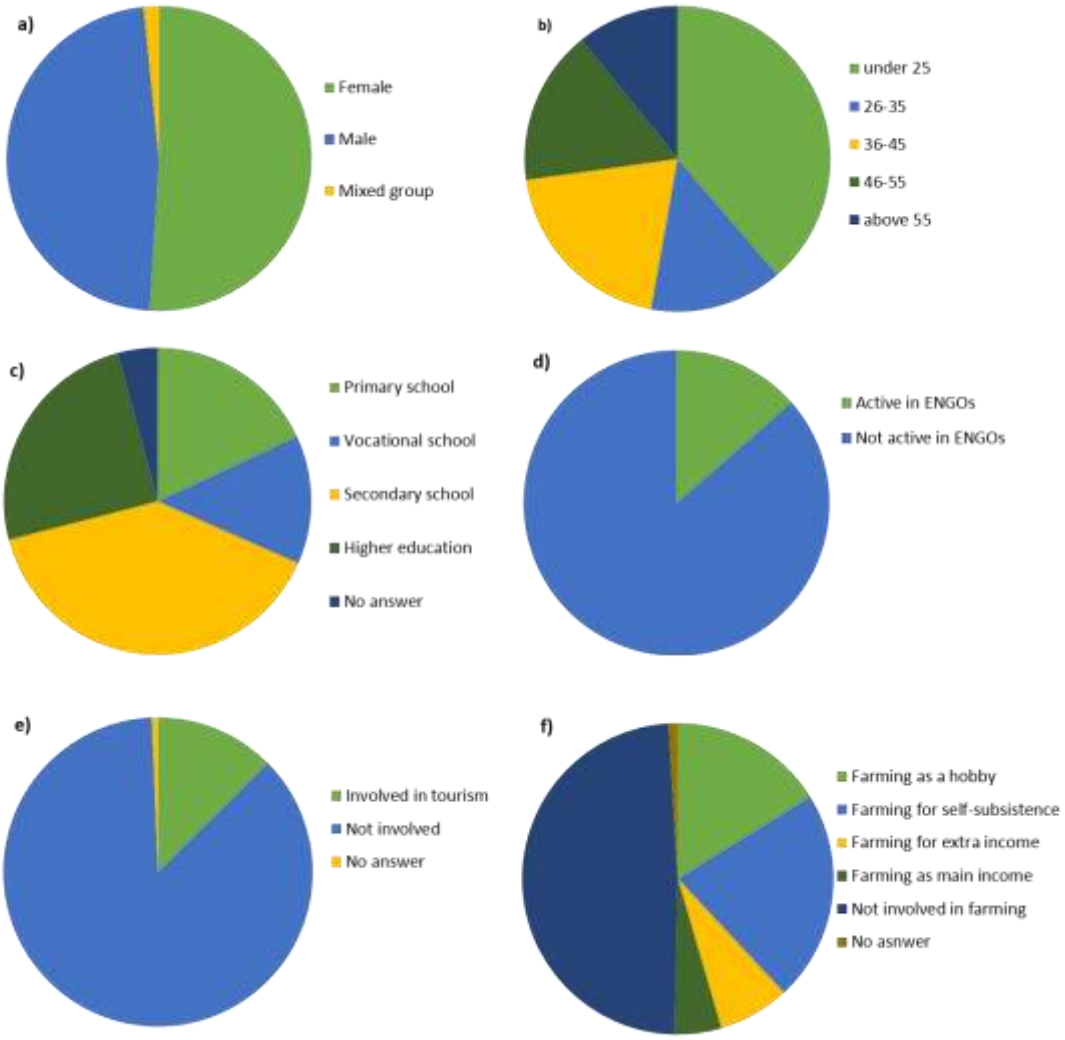


**Fig. 6.2:** Distribution of the different groups within the respondents in the preference assessment. **a)** the proportion of female, male and group responses within the sample **b)** The proportion of different age groups within the sample **c)** The school degree of respondents **d)** The proportion of respondents who are active in any civil organizations dealing with natural resources (Environmental NGOs) **e)** Respondents' involvement in tourism **f)** Respondents' involvement in agricultural activities.

The majority of respondents (87.1%) live in the research area. Almost half of the local respondents came from one settlement, Sângeorgiu de Pădure (Erdőszentgyörgy) (45.7%), that is located along river Târnava, while 29.7% of respondents came from three neighbouring settlements located along river Niraj (Miercurea Nirajului/Nyárádszereda, Gălești/Nyárádgálfa and Târnpa/Székelytompa). The remaining 24.5% of local respondents live in small settlements scattered within the research area. Local respondents usually spent most of their life in the research area with an average time span of 26.5 year. Those who do not live in the research area usually came from Târgu Mureș/ Marosvásárhely (40.5%) or other nearby towns in Transylvania (32.4%); only a minority of respondents said they lived either in Hungary (16.2%) or in third countries (5.4%). The majority of non-local respondents visit the research area on a monthly or weekly basis (40.5%), and all except one respondent said they had already visited the area at several times. This suggests that despite these respondents live outside the area they are quite familiar with it, thanks to their regular visits.

Age groups were represented unequally in the sample: young groups were heavily overrepresented (38.7% of respondents belong to the age group under 25,) and the elderly were underrepresented (people above 55 represented only 10.8% of the sample) (**Fig. 6.2 b**). This can partly be the result of involving students in the field campaign (they approached similar age groups more easily than elder people) and partly traced back to the chosen occasion for data collection (festivities attract more the younger generations than the elderly).

Respondents who finished secondary or higher education are overrepresented in the sample (39.3% and 24.8% respectively) which again reflects the unequal representation of different age groups (**Fig. 6.2 c**).

The last few questions focused on the different ways respondents can get into a direct relationship with nature: whether they were active members of non-governmental organizations that focus on the natural environment (e.g. fishing or hunting associations or environmental groups); or if they are involved in tourism or agriculture at the local scale. Only a minority of respondents are engaged with civil associations (**Fig. 6.2 d**) or the tourism sector (**Fig. 6.2 e**), but nearly half of them have certain stake in agriculture. Those who are involved in agriculture usually do farming as a hobby or for self-subsistence. Only 12.2% of respondents work in agriculture to receive regular income, either as the main source or as an adds-on to their regular monthly salaries (**Fig. 6.2 f**).

According to expert knowledge of the area, the proportion of respondents who are actively involved in agriculture seems significantly smaller in the sample than in reality. We can suppose that this is a result of biased sampling, and most likely stems from the overrepresentation of the young generations. We checked with a cross table analysis if there is significant differences between age groups in terms of the agricultural involvement of respondents and we found that non-farmer respondents are significantly overrepresented in the young generation (64.4% of respondents below the age 25 is NOT involved in agriculture) while farmers are overrepresented in the middle-aged and the elderly groups (57.8% of respondents between the age 25-55 and 72.7% of respondents above the age 55 are involved in agriculture).

### 6.1.3 The priority list of ecosystem services

The priority list of ecosystem services was created on the basis of respondents' votes. Each respondent could choose five items from the complete list of 12 ecosystem services: they were asked to select and then to rank the five selected ones according to their importance (i.e. put them to the first to fifth place in their individual priority lists). Based on the votes we calculated two different priority lists. The first list shows all ecosystem services from the most important to the less important one based on a simple arithmetic summation of individual votes (not taking into account if a certain ES was selected to the first or to the fifth place) (**Fig. 6.3 a**). The second list shows the weighted ranking of ES taking into account the relative importance of each service. In this list we multiplied the number of votes for each service by 5 if selected at the first place, by 4 if selected at the second place, by 3 if selected at the third place and so on until the fifth place where no multiplier effect was calculated (**Fig. 6.3 b**).

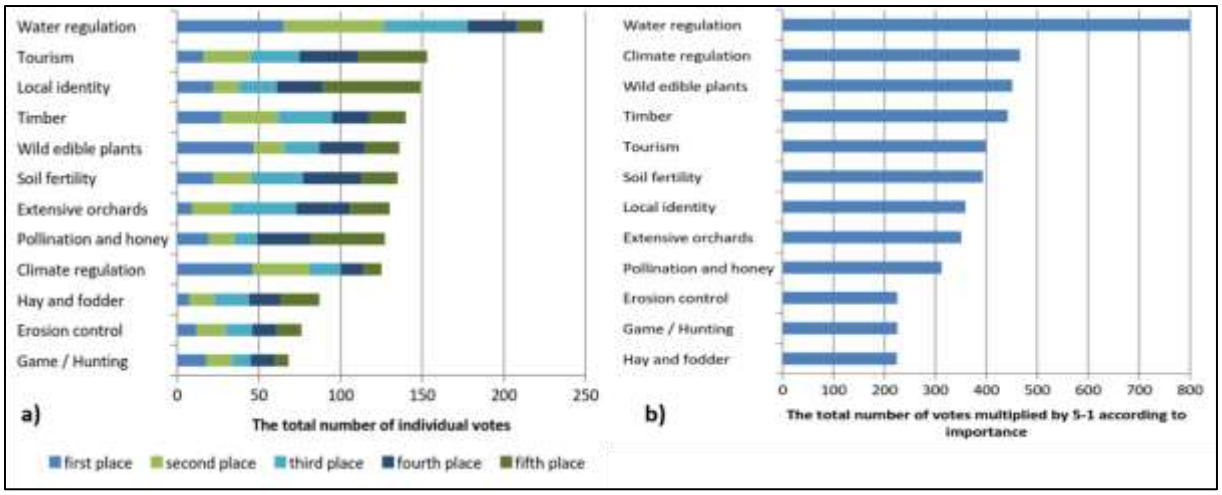


**Fig. 6.3**: The ranked list of ecosystem services **a)** showing how many times they were selected as the first to fifth most important service. **b)** weighted by their order of selection.

As we indicated in the methodology, there is a possibility of biased results due to the overrepresentation of the young generations (which is also a reason for the underrepresentation of respondents involved in agriculture) in the sample. To visualize this possible distortion, we created the same ES priority lists for two subpopulations of the sample. **Figure 6.4 a)** shows the ranked priority list of respondents under the age 25, while **Figure 6.4 b)** shows the ranked priority list of respondents who are involved in agriculture. Comparing these particular lists to **Figure 6.3 a)** (the priority list for the whole sample) we can see relatively small divergence:

- in both sub-groups tourism (2$^{nd}$ place in the whole sample) is replaced by local identity compared to the whole sample, but difference between the number of votes is minor
- except the higher importance of local identity, the sub-group of respondents involved in agriculture created the very same ranking for all the other services as the whole sample
- respondents under age 25 perceived soil fertility a bit more important than wild edible plants and ranked these two services to the 5$^{th}$ and 6$^{th}$ place (contrary to the 'farmers' group and the whole sample where these services were ranked to the 6$^{th}$ and 5$^{th}$ place respectively)
- respondents under age 25 perceived pollination and honey somewhat more important than extensive orchards and ranked these two services accordingly to the 7$^{th}$ and 8$^{th}$ place (contrary to the 'farmers' group and the whole sample where these services were ranked to the 8$^{th}$ and the 7$^{th}$ place respectively)
- respondents under age 25 ranked hunting higher than erosion control (11$^{th}$ and 12$^{th}$ respectively), contrary to the 'farmers' subgroup and the whole sample where these services were ranked to the 12$^{th}$ and the 11$^{th}$ place.

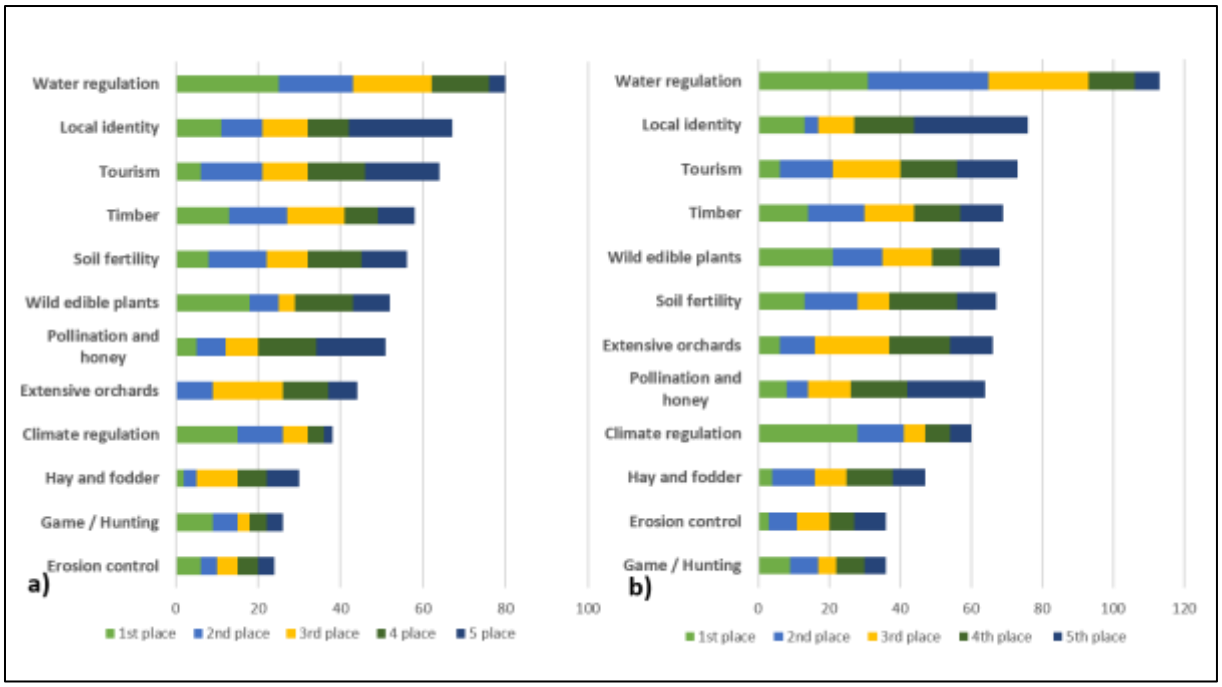


**Fig. 6.4**: The ranked list of ES **a)** for the age group under 25 **b)** for respondents involved in agriculture.

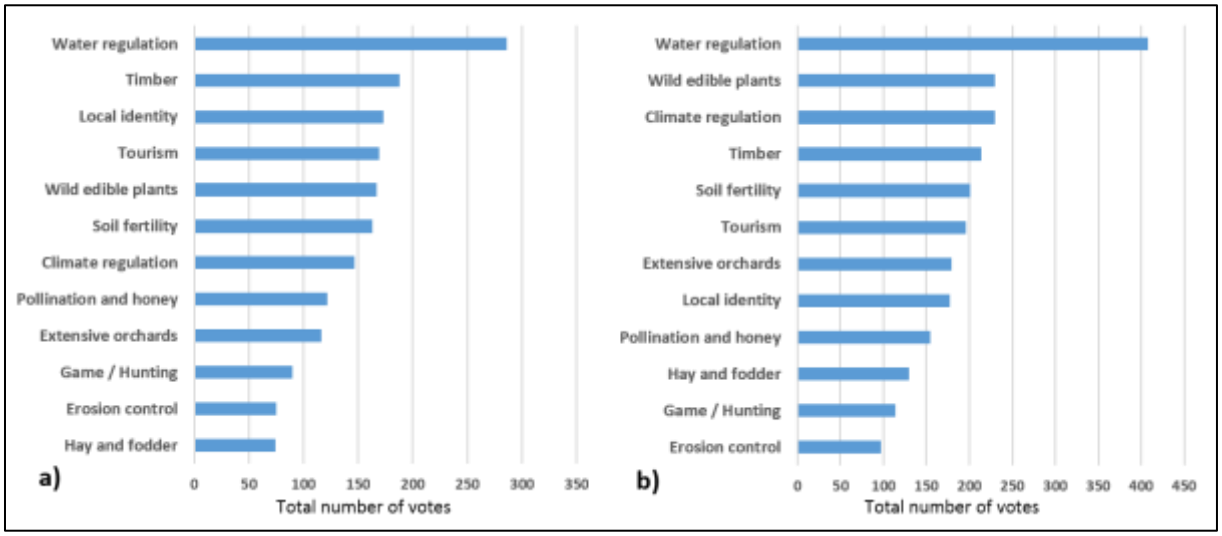


**Fig. 6.5:** The ranked list of ES weighted by the order of selection **a)** for the age group under 25 weighted by the order of selection **b)** for respondents involved in agriculture.

We also calculated the weighted ranks of ecosystem services for the two sub-groups (< 25 years; agricultural involvement. Results can be seen on **Fig. 6.5 a)** and **Fig. 6.5 b)**.

Comparing the weighted lists differences between the sub-groups' and the whole sample's preferences become more visible, although in all three lists the differences between the ranks are very small. It is remarkable that the sub-group of respondents involved in agriculture created a weighted list where ES related to the agriculture use of the area are ranked higher than other services: wild edible plants, soil fertility, extensive orchards and hay and fodder were attributed with more importance here than in the subgroups of the 'youth', as well as in the whole sample. The sub-group of the 'youth' shows more divergence from the whole sample than the sub-group of 'farmers'. Local identity is much more appreciated by respondents under age 25 (ranked to the 3$^{rd}$ place instead of the

7th in the whole sample and the 8th in the sub-group of 'farmers'), while climate regulation is perceived much less important (ranked to the 7th place instead of the 2nd and 3rd place in the whole sample and in the 'farmers' subgroup, respectively). There are other smaller divergences as well, which shows an increased interest of the young generation in services with relatively high economic value potential (e.g. timber ranked to the 2nd place, tourism ranked to the 4th place, honey ranked to the 8th place, game and hunting ranked to the 10th place).

### 6.1.4 Qualitative analysis of the justification of votes

Each respondent was asked to justify their votes in a few words. The justifications were collected and coded: every justification got a keyword (code) that express the containment of the respondents' answers (justifications with the same meaning but expressed in different words got the same keyword). After this step the justifications were quantified. In the following we summarize the most frequently mentioned justifications and their keywords. **Table 6.1** shows justifications groups with three or more votes.

**Table 6.1:** Ecosystem services and the most frequently mentioned justifications.

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| **Wild edible plants (WEP)** | WEP are healthy | WEP contribute to maintain the human health. They contain vitamins therefore they are good for preventing illnesses. | physical well-being |
| | medicine | These plants have therapeutic effects, they can be used as medicine in case of illnesses. | physical well-being |
| | chemical free | As wild edible plants can be found mainly in the forests, they are not polluted with chemicals. This justification is closely related to the justification "healthy". | physical well-being |
| | "because I like it" | Some of the respondents chose WEP because they simply like their flavour. | physical well-being, emotional considerations |
| | food | WEP are food for the human and for the animals, as well. | physical well-being |
| | livelihood | Gathering and selling raw or processed WEP is an important income for the locals. | economic considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | relaxation | During the collection of these plants, people can relax and enjoy the nature. | emotional considerations |
| | WEP are free | Wild edible plants are available for free, it is easy to obtain. | economic considerations |
| | other | They are delicious; they are readily and locally available; they have several uses; raw materials for pálinka or tea | physical well-being, economic considerations |
| **Climate regulation** | climate change as a global problem | Climate change must be prevented, reduced or stopped. Some respondents emphasized that climate regulation is important to avoid natural catastrophes, such as desertification or water level rise of seas and oceans. | physical well-being |
| | optimal climate | Some of the respondents gave a more focused justification. They said that climate regulation is important as it is contribute to keep the temperature in a level that make the Earth liveable. | physical well-being |
| | negative effects | A small group of respondents associated something negative but they could not expressed it in more details. | emotional considerations |
| | other | Many respondents chose climate regulation as one of the most important ecosystem service, but lot of them gave a justification that is not reflect directly to the real meaning of the ecosystem service. For example, they associated to the air pollution or they emphasized the importance of environmental protection. Some of the respondents said that climate regulation is important because of the fresh air or the oxygen production. These misunderstandings may emerge due to the complex meaning of this | physical well-being, ethical considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | | ecosystem service or the picture that we showed was misunderstandable. | |
| **Timber** | wood as fuel | More than one third of the respondents who chose timber said that it is important because it is used for heating. | economic considerations |
| | timber as the base of livelihood | The forest and the timber provide jobs therefore it contributes to the well-being of these people. | economic considerations |
| | timber as building material | Timber is one of the most important basic material of constructions. | economic considerations |
| | timber as furniture making material | Timber is one of the most important basic material of furnitures. | economic considerations |
| | stop the felling | Some of the respondents said that they chose the picture of timber because people should face the problem of immoderate felling. Environmental awareness and well-being aspects appear in this justification. | emotional/moral consideration |
| | oxygen production and clean air | Ecological functions of forests, mainly the ability of oxygen production, are important because they make the Earth liveable. Environmental awareness and well-being aspects appear in this justification. | physical well-being |
| | other | Versatile use: timber is important because it can be used for many purposes and it is easy to process; easy to extractive; forests as habitats; timber as the material of paper; carving as hobby | economic considerations, psychical considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| **Water regulation** | essential needs | High majority of the respondents did not understand correctly this ecosystem service, as they reflected to the importance of water. The main justification was that the water is a fundamental element of the life and without water there is no life. People need water every day. | physical well-being |
| | clean water | High number of people said that they chose this ecosystem service as the clean water is essential for the human. It is the basis of the human health therefore it is important to preserve the fresh water and keep the drinking water clean. The emphasis is on the cleanness. | physical well-being |
| | health | Some people linked together the essentiality and the importance of water and said that clean water is the basis of the human health. Clean water contributes to prevent infections. | physical well-being |
| | wildlife | Fresh water as habitat of animals and plants that needs liveable environment. This justification links to the previous one (clean water). | value-based considerations |
| | feeding, drinking water | A group of people chose this ecosystem service as it is contribute to the production of drinking water. Water is the habitat of fish that is an important source of food. | physical well-being |
| | fishing as livelihood | As fresh water provides habitat for fish, it provides income for fishermen. | economic considerations |
| | water pollution | Some of the respondents emphasized the problem of water pollution. | physical well-being |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | relaxation | Water gives opportunity to relax and have fun. | physical and psychical well-being |
| **Extensive orchards** | healthy | Fruit is healthy in itself, as it contains a lot of vitamins. Fruits are inevitable for the proper functioning of the human body. | physical well-being |
| | pálinka | Pálinka is a traditional short drink in Transylvania and Hungary, and it is made from fruit. Extensive orchards are valuable sources of fruit that can be used for making pálinka. | economic considerations, physical well-being |
| | chemical free | Extensive orchards are important as they are not treated with chemicals. | physical well-being |
| | livelihood | Extensive orchards provide economic basis for the locals. Selling fruit and fruit-based products make available for them to get some perquisite. | economic considerations |
| | home made | Fruit that people produce for themselves have intrinsic value. Respondents said that these fruit are more delicious as they know and saw how the fruit was grown. | psychical well-being |
| | delicious | Fruits are simply delicious. | physical well-being |
| | feeding | Fruit is food. | physical well-being |
| | national | Those who answered like this said that is important for them to eat national products. | psychical well-being |
| | resistivity | Extensive fruit species are more resistant (against plant illnesses) than the intensive species. | economic consideration |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | genetic resource | Extensive fruit species contribute to the maintenance of the diversity of species. | value-based considerations |
| | tradition | Extensive orchards preserve the traditional fruit producing techniques. | emotional considerations |
| | jam | Fruit is the ingredient of jam which is delicious, cheap and local. | economic consideration |
| **Game/Hunting** | delicious | Most of those who chose this ecosystem service said that game meat is more delicious than the meat of domesticated animals. | physical well-being, psychical well-being |
| | feeding | Game meat is an important basis of the food production. | physical well-being, economic considerations |
| | relaxation | Hunting is a form of relaxation, it is a hobby. | psychical well-being |
| | wildlife | Game are part of the wildlife, they must be protected and the management of them should be sustainable. | value-based considerations |
| | game damage | A small group of respondents by choosing this ecosystem service tried to give emphasis to the expense of game. | economic considerations |
| | personal attachment | Some of the respondents chose this ecosystem service because they think that hunting is necessary and they also hunt. | emotional considerations |
| **Tourism** | livelihood, development | Tourism is a fundamental economic opportunity for the locals. It maintains jobs, increases the income of the villages. Tourists bring money to the region and this is the way of development that locals would kindly promote. | economic considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | knowledge of the landscape | It is important to explore and learn about the nature, the landscape. Tourism is an opportunity to show how nice and valuable is the area of Niraj and Târnava Mică. | psychical well-being |
| | the pleasure of having an excursion | Tourism means that people can enjoy the nature. It is a good way of relaxation as nature is comforting. Respondents who chose this ecosystem service like to have excursions. | physical and psychical well-being |
| | good conditions | The area of Niraj and Târnava Mică has good conditions for tourism as there is a lot of natural beauty. | ? |
| | nice landscape | Some people chose this ecosystem service because the picture reminded them to the beautiful landscapes of the area of Niraj and Târnava Mică. | psychical well-being |
| | more tourists | Some of the respondents chose this picture as they wanted to see more tourists in the area. | economic considerations |
| | clean environment | According to some respondents an landscape is impressive for the tourists, if it is clean and well-kept. | physical and psychical considerations |
| | valuable nature | The landscape is part of the life of locals. It represents the cultural traditions. It is a heritage that should be maintained and showed to the tourists. | emotional considerations |
| **Soil fertility** | fertility | Fertile and quality soil contributes to the production of healthy and quality food. Soil is the basis of the food production therefore it is inevitable to maintain its fertility and keep it clean. Fertility is a value. | physical well-being and economic considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | agriculture and plant production | Soil is necessary for the plant production. Justifications in this group emphasized the importance of plant production and agriculture. Soil must be easy to process and fertile to get good harvest. Soil is the source of food, the basis of the agriculture. | economic considerations, physical well-being |
| | livelihood | Fertile soil has economic value. It is vital for the agriculture that is a basis of living in the rural areas. | economic considerations |
| | soil as habitat | Soil is a habitat for many useful living organism therefore its quality must be maintained. | value-based considerations |
| **Pollination and honey** | pollination | Pollination is inevitable for the plants to go to seed. Without pollination there is no harvest. | economic considerations |
| | health | The honey is part of the healthy living as it contains a lot of vitamins. | physical well-being |
| | delicious | Honey is delicious. | physical well-being |
| | food | Honey is an important food and sweetener, it can be used for cooking | physical well-being |
| | medicine | Honey is good for preventing and treating illnesses. | physical well-being |
| | livelihood | Producing and selling honey provides income for the beekeepers. | economic considerations |
| **Hay and fodder** | animal keeping | More than two-thirds of the respondents thought that hay and fodder is an important ecosystem service because hay is an essential need for livestock farming. | economic considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | livelihood | Livestock farming is one of the main way of living in the area. To maintain the livestock farming, reach hay fields are needed. | economic considerations |
| **Erosion control** | tree cutting | Most of the respondents thought that forests have a great contribution to preventing erosion. According to them, tree cutting had an increasing tendency and it should be controlled and stopped. | ? |
| | landslides | Some people associated to landslides that can cause serious damages. | economic considerations, physical well-being |
| | preventing soil erosion | A few respondents emphasized simply that soil erosion is a negative process and it should be prevented. | ? |
| | crop production | Preventing soil erosion is important to get rich harvest. | economic considerations |
| **Local identity** | to honour the tradition | More than half of the respondents thought that local identity is important as communities must maintain their traditions. Local values such as culture, folk custom, folk-tales, folk-dances must be taught to children and acquainted with tourists and other communities. Maintaining traditions means respect to the ancestors. | emotional and value-based considerations |
| | emotional attachment | Emotional attachment is part of the local identity. People live here are attached to their families, friends, to the landscape. Strong attachment to the homeland. | emotional and value-based considerations |
| | national consciousness | Some of the respondents thought that local identity is shaped by the Hungarians identity. They chose this ecosystem | emotional and value-based considerations |

| Ecosystem services | Justification category ID | Detailed justification | Type of consideration |
|---|---|---|---|
| | | service as one of the most important because they are Hungarians. | |

### 6.1.5 Cross-table analysis

The last section of our analysis focused on specific patterns of preferences of different sub-groups of the sample. We carried out cross-table analyses to check if there are group-specific preferences towards the seven most important ecosystem services (taking into account the ranked list of the whole sample). Key characteristics that have been checked against group-specific preferences were the gender, the school-degree and the location of the home town of respondents, as well as whether the respondents were involved in agriculture or not. Significant differences among sub-groups could be identified along two aspects: gender (**Fig. 6.6 a**) and location (**Fig. 6.6 b**). The first suggests that women perceive local identity as much more important than men, and also attribute somewhat more importance to wild edible plants, tourism and climate regulation, while men perceive timber and soil fertility more important than women. This finding is in line with previous results from Hungary, where timber seemed to be a masculine, and herbal plants and biodiversity conservation were considered a feminine ES (Kelemen et al. 2015), and can be partly explained by feminist literature pointing to the fact that family and work relations determine male and female roles and how male and female family members participate in resource management (i.e. both genders will appreciate those ES which are used by them).

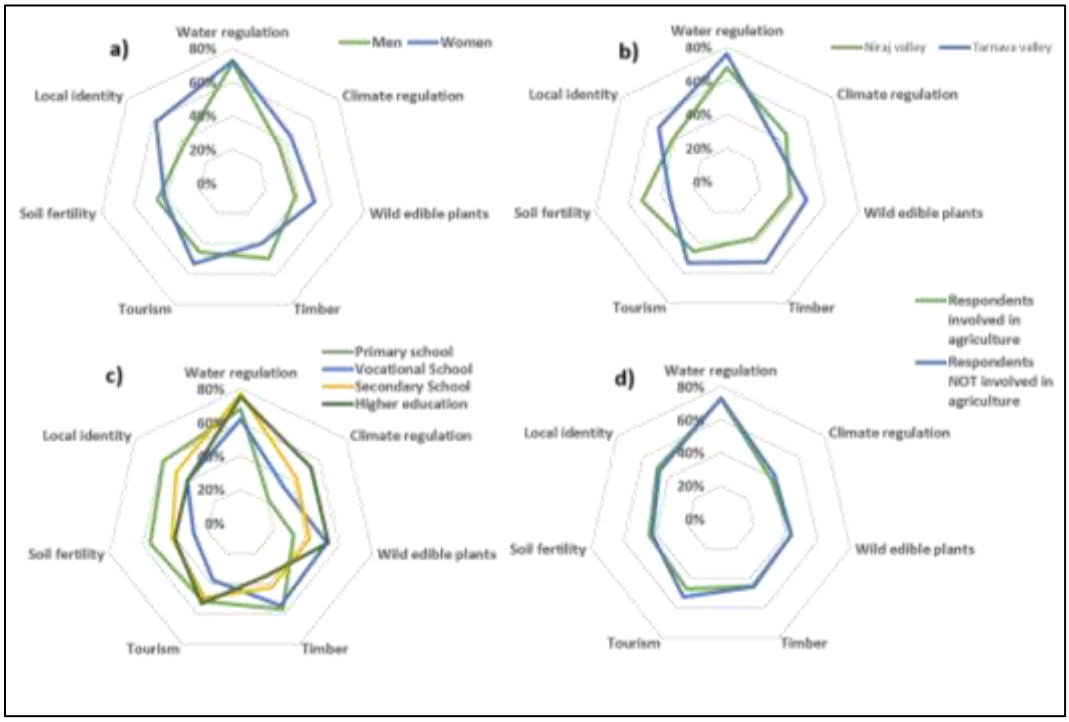


**Fig. 6.6:** Which proportion of respondents belonging to the different groups selected the given ES as a priority one? Diverging preferences according to **a)** gender **b)** the hometown of respondents **c)** school degree **d)** to involvement in agriculture.

**Fig. 6.6 b)** suggests that soil fertility and climate regulations are specific ES that are highly appreciated by respondents living along the River Niraj, than inhabitants of the Târnava valley. On the other hand, respondents living along the River Târnava perceived timber and local identity significantly more important, and wild edible plants, tourism and water regulation somewhat more important than the inhabitants of the Niraj valley. This result shows explicit links to the differences of habitat types and the actual use of ecosystem services between the two parts of the research area: the Târnava valley is rich in forests (providing timber and wild edible plants), while grasslands and small-scale agricultural fields are more prominent in the Niraj valley (most dependent on soil fertility).

**Fig. 6.6 c)** shows the relationship between the level of education and preferences to ES. Except climate regulation there is no systematic and significant differences among the different groups, however, it is notable that the perceived importance of climate regulation increases with higher school degree.

**Fig. 6.6 d)** compares the preferences towards the seven most important ES of respondents who are involved in agriculture and who indicated no direct links to farming and shows no significant differences in the preferences of these two groups. This is in line with previous results where we compared the priority list of the 'farmers' sub-group and that of the whole sample. We suppose that the only significant divergence would be the perceived importance of hay and fodder (although it is not indicated here as hay and fodder was not ranked among the most important ones).

## 6.2 Selecting ecosystem service and condition indicators for mapping and assessment

For any ES valued by locals as important that we want to include in the assessment, a matching indicator is needed, that actually represents the service as closely as possible. For some services this is a rather trivial choice, while for others some abstractions, combinations or specifications of certain aspects have to be made.

### 6.2.1 The indicator selection process

To select indicators for ES mapping (*Chapter 7*) we started out from both the results from the preference assessment process and the few 'predefined' ESs that were included in our Niraj-MAES project proposal accepted for funding by the EEA grant operators. In choosing indicators also methodological and conceptual aspects - based on MAES and CICES recommendations - were integrated. These processes are documented in **Table 6.2** and **6.3**

**Table 6.2: T**he indicator selection process for the ES resulting from the preference assessment.

| Rank | ES name in preference assessment | Methodological and data considerations | Proposed ES indicator name |
|---|---|---|---|
| 1 | Water regulation | As the factors for slowing down runoff and increasing infiltration are largely the same that determine erosion rates, we propose an indicator in common with erosion control | Water retention & erosion control (erosion) |
| 2 | Tourism | As the contribution of ecosystems to tourism is determined largely by the same natural factors as the contribution of ecosystems to the development of local identity, we propose an indicator in common with local identity | Touristic attractiveness& local identity (tourism) |
| 3 | Local identity | See above at tourism. | Touristic attractiveness & local identity (tourism) |
| 4 | Timber | Assigning an indicator to this service was relatively straightforward and problem-free. | Wood and timber (timber) |
| 5 | Wild edible plants (WEP) | The definition was agreed to be broadened to contain wild fruits, medicinal herbs & edible mushrooms according to the most important “wild crop” types of the region (which is in line with the photos shown during the elicitation survey) | Medicinal and edible plants and mushrooms (gathered) |
| 6 | Soil fertility | This ES is considered both as an ecosystem state descriptor (cascade level 1), and as a final service (cascade level 2) which provides inputs for agriculture (contributing crucially to agricultural products). See also the comments below for "extensive orchards", and the comments for "agriculture crop production" in **Table 6.3**. | Soil fertility (fertility) |
| 7 | Extensive orchards | Fruits from orchards can be both seen as an ecosystem service and an economic product (depending on how you set the production boundary). Following MAES recommendations in order to avoid double counting we consistently consider agroecosystems as parts of the human economy, and their main products as economic products. On the other hand, as ecosystem services we choose to consider (and quantify) the natural inputs into agroecosystems (e.g. soil fertility, pollination) as well as the by-products (e.g. nectar from crops) of these systems. (Beyond conceptual problems, | -- |

| Rank | ES name in preference assessment | Methodological and data considerations | Proposed ES indicator name |
|---|---|---|---|
| | | the low rank that this service scored during the preference assessment process also contributed to dropping it.) | |
| 8 | Pollination and honey | As most of the arguments received during the preference assessment was related to honey, we moved honey (nectar) provisioning capacity to our primary focus. (The abundance of pollinators is also influenced by the abundance of nectar sources, so the resulting indicator will still describe pollination, too.) Even though this ES has been ranked relatively low, we still kept it as an indicator to be developed because of its relative straightforward link to ecosystems and economy, the fact that the resulting indicator is also related to a regulating service important for crop production (pollination), and as the related provisioning service (honey) was mentioned among the predefined services of our project proposal. | Honey provision and pollination (honey) |
| 9 | Climate regulation | Even though in terms of total number of mentioning this service was ranked only the 9th, whenever it was mentioned it was mentioned at one of the first positions. Furthermore, “carbon sequestration” was also one of the predefined services, so we included this service in our indicator work. | Carbon sequestration (carbon) |
| 10 | Hay and fodder | This ES would have been dropped because of the low rank received – but was still kept as the SAB expressed its strong preference for having this regionally and historically important service evaluated. Furthermore, “hay production” was one of the predefined services in our application. | Natural forage and fodder (hay) |
| 11 | Erosion control | This ES would have been dropped because of the low rank received – but was still kept because soil erosion can be mapped using the same indicator as water regulation, the ES ranked highest in our preference assessment. | Water retention & erosion control (erosion) |
| 12 | Game/Hunting | This ES was dropped because of the low rank received | -- |

**Table 6.3:** The indicator selection process for the ES from the predefined ES list (B).

| ES name used | Methodological and data considerations | Proposed ES indicator name (+short name) |
|---|---|---|
| Agriculture crop production | Agricultural crops can be both seen as an ecosystem service and an economic product (depending on how you set the production boundary). Following MAES recommendations in order to avoid double counting we consistently consider agroecosystems as parts of the human economy, and their main products as economic products. Thus we do not try to quantify the "capacities" for individual crop types at the second cascade level -- we quantify instead the natural inputs into agroecosystems (e.g. soil fertility, pollination) here. However on the level of actual use (third level of the ES cascade) we also include agricultural crop production into the discussion. | Soil fertility (fertility), honey provision and pollination (honey) |
| Hay production | The SAB also promoted this ES as regionally important in the past and potentially also in the future. The service was generalized to all kinds of livestock fodder from (semi-) natural grasslands | Natural forage and fodder (hay) |
| Provisioning services from seminatural ecosystems (e.g. fish, game, mushrooms, honey) | Wild plants and mushrooms gathered was also highly ranked by the preference assessment. | Medicinal and edible plants and mushrooms (berry), honey provision and pollination (honey) |
| Carbon sequestration | See comments for "climate regulation" in **Table 6.2** | Carbon sequestration (carbon) |
| Habitat for biodiversity | This service, frequently considered as a "supporting service", can most appropriately be conceptualized as an ecosystem state descriptor (cascade level 1) in the ES cascade framework. | Habitat naturalness (naturalness) |
| Recreational potential | The features landscape offers for recreation and creating emotional attraction are mostly the same that are capable of attracting tourists, therefore this service was integrated in “Touristic attractiveness” | Touristic attractiveness & local identity (tourism) |

### 6.2.2 Final list of indicators

As a next step, uniting the previously presented considerations on local preferences with the predefined ES list as well as the methodological and conceptual issues, the final list of indicators was drafted. The potential indicators were defined more precisely, and appropriate methods were identified for modelling them (for details on models and the modelling process see *Chapter 7*). This lead to the following list of 10 ES indicators - seven ES indicators and three ecosystem condition indicators:

**Table 6.4:** The list of ES indicators and ecosystem condition indicators selected for mapping in the Niraj-MAES project. Modelling approaches show the steps towards the final models (planned models/model development), for details of final models see *Chapter 7.3*.

| Short name | Long name | Definition of the ES indicator | Cas-cade level | Modelling approaches |
|---|---|---|---|---|
| natural-ness | habitat naturaln ess | The naturalness (incl. biodiversity and resilience) of the habitat. This ecosystem state influences the provision of several ecosystem services within and beyond the ones studied in this project, e.g. pest control, disease control, pollination. | 1 | (1) statistical modelling (a Tier 2 index based on the modelled occurrence probabilities of some taxonomical groups of conservational significance) |
| landiv | landsca pe diversity | The habitat diversity of the broader landscape, which contributes to the persistence of several plant and animal species, as well to an aesthetically appealing environment. | 1 | statistical model (a Tier 2 landscape index: the diversity of broad habitat types under a moving window) |
| fertility | soil fertility | Fertility of the soil is a semi-persistent ecosystem state affecting the supply of several ES. In case of agro-ecosystems, it determines the ecosystem's potential contribution to the agricultural yield. | 1 | expert scores based on primary data (Soil Map of Romania (Harta Solurilor 1978)) |
| hay | natural forage and fodder | Potential forage supply provided by the ecosystems through mowing or grazing. Cultivated or marketed roughage and grain feed are not included while grazing on fallow land and stubble as well as grasses spontaneously occurring on waysides and banks are included in this service. | 2 | matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced matrix model (a Tier 2 statistical model with additional expert rules |

| Short name | Long name | Definition of the ES indicator | Cas-cade level | Modelling approaches |
|---|---|---|---|---|
| timber | wood and timber | Long-term timber and firewood provisioning potential of the habitat, assessed as a yearly average considering the whole lifecycle of the habitat, not taking effects of climate change into account. | 2 | (1) matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced matrix model (a Tier 2 statistical model based on forestry production tables (Tabele de producție (Giurgiu et al. 2004)) |
| berry | medicinal and edible plants and mushrooms | Gathered mushrooms, fruits, berries and medicinal herbs provided spontaneously by the habitat. Cultivated plants and mushrooms are not included. | 2 | (1) matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced matrix model (a Tier 2 statistical model based on structured exploration of plant habitat preferences) |
| honey | honey provision and pollination | Potential of the habitat to supply nectar and pollen for honeybees and so contribute to honey production. | 2 | (1) matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced model (a Tier 2 statistical model based on habitat types and slope categories) |
| erosion | water retention & erosion control | Contribution of the land cover to slowing down the passage of surface water and thus to the recharge of regional groundwater resources and the mitigation of soil erosion. | 2 | (1) matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced model (a Tier 2 statistical model based on habitat types and slope categories) |
| carbon | carbon sequestration | Sequestration and storage of atmospheric carbon by the habitat, as contribution to global climate change mitigation. | 2-3 | IPCC model (adapting a Tier 1 IPCC national greenhouse gas inventory model to the Niraj-MAES area) |
| tourism | tourism and local identity | Contribution of the habitat to the touristic attraction value of the area. Habitats allow recreation and create emotional bond in local people. | 2 | (1) matrix model (a Tier 1 statistical model based on expert scores and a habitat map)<br>(2) enhanced model (an ESTIMAP-style Tier 2 statistical model based on the matrix model & additional rules) |

In the case of several ES indicators (e.g. timber, berry, tourism) we planned for several alternative indicator versions to be created during the indicator quantification process. The alternative versions provided a nested refinement structure, by which we could move from a rough to finer and more detailed estimations. We also provide a link to the cascade levels, and the tiered approach of MAES (see e.g. in Maes et al. 2014). As most of the mapping and modelling approaches, the methods listed here are designed to work at the ecosystem condition (cascade level 1, see **Fig. 4.1**) and ES capacity (potential supply, cascade level 2) levels. In the Niraj-MAES project we also try to quantify the actual use of ESs (cascade level 3) wherever there were enough data. Comparing potential supply to actual use can help to formulate policy relevant messages (as to be seen in *Chapter 11*) .

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# 7. Mapping and modelling ecosystem services in the Niraj - Târnava Mică region

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In order to be able to give a meaningful overview of ecosystem services, the flow of services from nature towards society (**Fig. 7.1**) needs to be thoroughly examined and understood. This process can best be described by the so called 'cascade model', the starting point of which is the *condition of ecosystems* (level 1) that fundamentally determines their internal processes and operation. This condition enables ecosystems to provide services (*capacity*, level 2). However, the capacity of ecosystems to provide certain services is not the same as the services actually used (*actual use*, level 3) as the latter can be influenced by societal needs, 'demand' at a given place and time, as well as the human inputs expended to obtain services. The benefits of the services used then appear in the form of maintained or increased *well-being* in society (level 4).

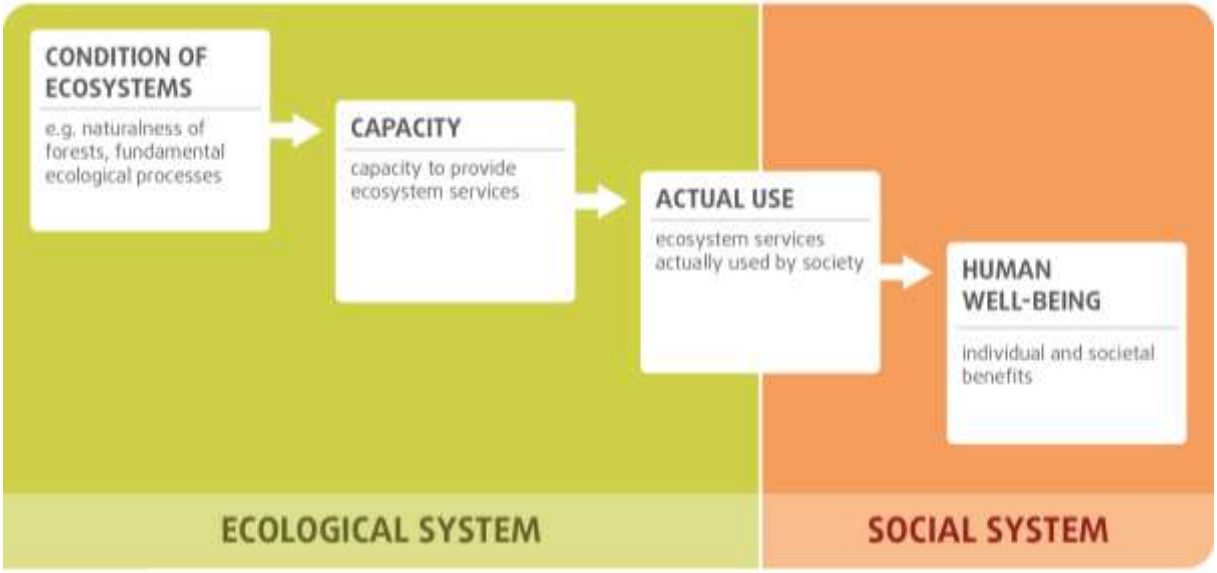


**Fig. 7.1:** The cascade model: the flow of ecosystem services from nature towards society.

In this study, mapping means spatially explicit assessment on the cascade levels 1 and 2 (ecosystem condition and capacity). Assessment of actual use of services and benefits (cascade levels 3 and 4) was performed without mapping and reported in *Chapter 8* (Valuation and actual use of ES). To quantify ecosystem condition and ES capacity in space, we need models that link input data (maps) to ES indicators. In *Chapter 7.1*, the process of input map compilation is described, as well as the additional spatial data that were used for mapping and modelling. There is a broad variety of models used to link the maps with actual ES indicators, which are presented in detail in *Chapter 7.2*. The finally used models are described in *Chapter 7.3*.

## 7.1 Input maps

### 7.1.1 Ecosystem map (Habitat map)

The key input layer for any ES mapping and assessment activity is a map classifying the landscape of the study area according to the fundamental functional units (ecosystem types or habitat types, see e.g. Maes et al. 2014) This map is frequently called an "ecosystem map" or "habitat map". Our ecosystem map covers the four overlapping protected areas: "*ROSCI0384 Râul Târnava Mică*" (Târnava Mică River), *ROSCI0297 Dealurile Târnavei Mici – Bicheș*" (Târnava Mică - Bicheș Hills), "*ROSCI0186 Pădurile de stejar pufos pe Târnava Mare*" (The downy oak forests on Târnava Mare), and "*ROSPA0028 Dealurile Târnavelor și Valea Nirajului*" (Târnave Hills and Niraj Valley), the latter including major parts of the former three. The limits of the map area were obtained by dissolving the limits of the four protected areas, resulting in a surface of 91 557 hectares (sum of the overlapping areas and the non-overlapping areas). The basic map of ecosystems was made in QGIS (Quantum Gis 2.10.1. Pisa) programme, in the Dealul Piscului 1970/Stereo70 coordinate reference system (the official national coordinate system in Romania). The result was a multipart polygon without gaps or overlaps, with an attribute table containing the ecosystem types (habitat types) and the areas of each feature.

In the process of creating the map, the following sources were available:

- Google Satellite and Google Streets and Terrain layers from the 'open layers' plug-in of the QGIS programme;
- outdated non-official aerial photographs;
- map of land use within the protected area, from a former biodiversity evaluation project for (Elaboration of Integrated Management Plan for ROSPA0028, ROSCI0186, ROSCI0297 and ROSCI0384 - "*Elaborare Plan de Management integrat pentru siturile ROSPA0028, ROSCI0186, ROSCI0297 si ROSCI0384"*[4], within the project "Biodiversity and Sustainable Development in Niraj and Târnava Mică Valleys" – *"Biodiversitate si dezvoltare durabilă în Valea Nirajului și a Târnavei Mici"* - 2014);
- map of the forested sites of community importance (Natura 2000) within the protected areas, from the same project as the land use map;
- forestry data obtained from state and private forest offices, from the same project as the land use map;
- grassland survey maps, from a grassland evaluation study realized as a follow-up to the former mentioned project
- Corine Landcover maps (http://land.copernicus.eu/pan-european/corine-land-cover)

The list of ecosystem types was created based on previous project experiences (OpenNess FP7), customized to the local landscape and available information. The final list of ecosystem types is shown in **Table 7.1**.

[4] Ordinul MMAP nr. 1553/2016 - aprobarea Planului de management şi a Regulamentului siturilor Natura 2000 ROSPA0028 Dealurile Târnavelor şi Valea Nirajului, ROSCI0186 Pădurile de Stejar Pufos de pe Târnava Mare, ROSCI0297 Dealurile Târnavei Mici — Biches si ROSCI0384 Râul Târnava Mică

**Table 7.1:** The final list of ecosystem (or habitat) types distinguished in our habitat (ecosystem) map.

| habitat category (ecosystem type) | definition | criteria for delineation | relative area |
|---|---|---|---|
| settlement | villages, outer areas with gardens and single farms | easily recognizable (on the basis of the satellite images) | 1.7% |
| intensive agricultural | intensive, large arable fields (patches >10 ha) | homogenous arable land patches larger than 10 hectares (on the basis of the satellite images) | 0.5% |
| extensive agricultural | mixed agricultural mosaic of small patches of various uses (patches <10 ha) | any patchy landscape, with patches smaller than 10 hectares (on the basis of the satellite images) | 12.7% |
| pasture | pastures, grazed grasslands of different degrees of degradation | large patches of homogenous grassland areas (on the basis of the satellite images, at scales of 1:9000 and 1:11 000), sometimes with visible signs of overgrazing (eroded parts in the fields) | 26.7% |
| hay meadow | hay meadows | separated from pastures based on the land use map | 6.9% |
| encroached grassland | shrublands, abandoned grasslands encroached with shrubs | grassland patches with more than about 30% covered by shrubs (estimated visually on the satellite images at the scales of 1:5000 and 1:11 000) | 7.6% |
| wood pasture | solitary trees in grassland patches | easily recognizable by the solitary trees in grassland patches (on the basis of the satellite images) | 1.6% |
| orchard | abandoned or extensively used fruit tree plantations/vineyards | areas with tree or shrub plantations in rows, visible on the satellite images (at a scale of 1:11 000), which were marked as fruit tree plantations or vineyards on the land use map as well | 0.4% |
| tree row | group of trees/small forests/tree rows/galleries along small valleys | small groups of trees, thick and continuous shrublands, galleries along valleys and rivers located in larger grasslands, | 3.8% |

| habitat category (ecosystem type) | definition | criteria for delineation | relative area |
|---|---|---|---|
| | | agricultural lands, or along the riverbanks (on the basis of the satellite images) | |
| pine and spruce forest | coniferous plantations | within forests: extreme dark colours on LANDSAT 8 false-colour maps (Bands 5, 4, 3); checked with forestry data where available | 1.3% |
| robinia forest | robinia plantations | within forests: light colours on LANDSAT 8 false-colour maps (Bands 5, 4, 3); checked with forestry data where available | 0.1% |
| broad-leaved forest | deciduous forests of native tree species | all large forest areas (on the basis of the satellite images), apart from coniferous forests and robinia plantations | 35.6% |
| wetland and water | major rivers, lakes and fisheries, including the reed banks | major rivers within the project area (Niraj and Târnava Mică), and the lakes and fisheries, including the reed banks (as these surfaces were relatively small) (on the basis of the satellite images and Google Terrain layer) | 1.1% |

Ecosystem / habitat types were selected by consulting the available sources, and considering their precision in the edges of the patches, how detailed they were, and how much they reflected reality. The map layers were overlapped with Google satellite images, and personal field experience was also taken into account when evaluating the accuracy of the layers. The aim was to make categories broad enough to

- avoid uncertainties in the types of the features,
- avoid unfeasible workload during the satellite interpretation
- but still fine enough to be meaningful for assessing the relevant ES.

As Google satellite images seemed to be more suitable in several features than Corine Landcover maps (more detailed, more precise) and the available aerial photographs (more recent), it was decided to use them as basis. The shape was obtained by merging fragments of digitized satellite images, but as these fragments were detailed at different levels (for example the roads or the rivers were not digitized in every fragment), the detail level of the final shape was adjusted to the roughest.

The forestry data, which covered all forested areas, was incomplete regarding species composition, because some forest offices did not provide this information. As a result, the separation of the different forest types was realized through other methods. The primary category “forests” was further

separated into pine/spruce forests, robinia forests and other deciduous forests. For separation LANDSAT 8 false-colour maps were used (Bands 5 (near infrared), 4 (red) and 3 (green) - represented as red, green, blue on the map). This is a traditional band combination for evaluating vegetation (http://earthobservatory.nasa.gov/Features/FalseColor) and has been already in use for distinguishing coniferous forests, robinia forests and other decidious forests. Forests selected based on base map were checked and re-classified, where light colours indicated robinia forests, and extreme dark colours indicated coniferous forests. Re-classification was checked during processing with forestry data if available.

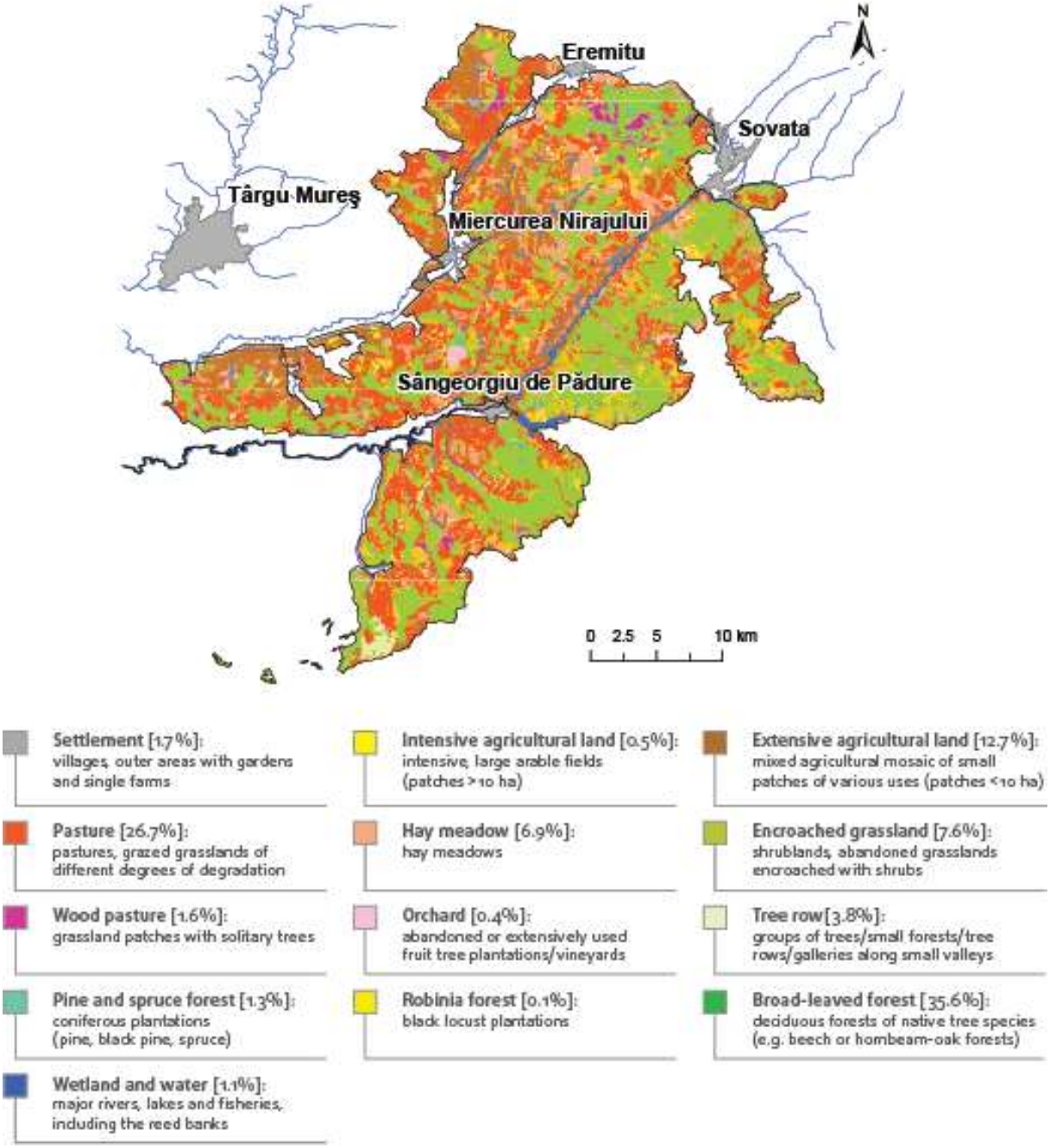


**Fig. 7.2:** Ecosystem map (habitat map) with the finally used 13 categories of habitat types.

Even though there were concerns about the accuracy of the land use map, it was used for delineating pastures from meadows. The decision to do so was based on the unanimous/repeated request of

participants at the matrix WS as well as at the SAB 3 meeting, which showed that even if the results are not exact, some representation of these two different land use types/habitat types is inevitable.

Finally, all linear infrastructure features (e.g. roads) were incorporated into the adjacent habitat patches. The resulting ecosystem map (habitat map) can be seen in **Fig. 7.2**.

In the making of the ecosystem map we generally preferred to use satellite images, being closer to the field reality, instead of the informations from the few available ready-made maps with a high or unknown degree of uncertainty.

### 7.1.2 Additional spatial data

Ecosystem maps are the bases for most types of ESs to be assessed. However, for refining the assessment, we have to add more spatial data (see next chapter, 7.3) Here we give an overview of the additionally used datasets.

Maps of roads and rivers were downloaded as line features from https://market.trimbledata.com for the project area:

- for **roads** the layer "highway_line.shp" was used, with the following categories chosen to be included: "trunk", "primary", "secondary", "tertiary" and all "links", "residential", and "living street" (the latter two categories in order to mark settlements, as no separate settlement data was used apart from base map categories);
- for **rivers** the layer "waterway_line.shp" was used – even though this is not a fully comprehensive map of all waterflows, it was still considered an enhancement to the rasterized and very rough "water and wetland" category of the base map.

From these layers two secondary raster layers were calculated with Euclidean distances:

- distance from roads/settlements, and
- distance from water.

To allow for modelling **elevations** we used the Shuttle Radar Topography Mission data (SRTM, https://earthexplorer.usgs.gov/). SRTM represents the best quality, freely available digital elevation models (DEMs) worldwide (Nikolakopoulos et al. 2006). From this dataset we calculated two secondary model input variables as raster datasets in QGIS:

- **slope steepness**, and
- **slope aspect**.

Raster layers describing various **soil** characteristics were created from the Soil Map of Romania (Harta Solurilor 1978) using the soil types.

**Grazing intensity** was considered to be a relevant characteristic of grassland ecosystems (pastures and wood pastures) in the case of several services. To cover this aspect we created a raster layer which contained average grazing livestock density for each pixel of pasture or wood pasture habitat. Average grazing livestock density values were calculated in livestock units (LU) from data collected from each community on the number of grazed cattle and sheep.

Raw shortwave and NIR surface **reflectance values** were also applied in a single modelling exercise (for assessing habitat naturalness). We downloaded Landsat 8 OLI & TIRS imagery for a cloud-free day (2014-12-04) from https://search.earthdata.nasa.gov/. We calculated average reflectance values and

reflectance variance for the 4x4 Landsat pixels around the centre of each grid cell of the ecosystem map from Landsat 8 bands 3, 4 and 5.

All input data were converted to 100 x 100 m grid sized raster-files. GIS data manipulations were performed in ArcGIS (ESRI 2011), QGIS (QGIS Development Team 2016), R (R Core Team, 2016) with add-on packages *sp* (Pebesma & Bivand, 2005), *rgdal* (Bivand et al. 2016), and *raster* (Hijmans, 2016), and QUICKScan (Verweij et al. 2016), a GIS environment specifically designed to support participatory ES assessment processes.

## 7.2 Modelling ecosystem services and ecosystem conditions

In the procedure of mapping and assessing the ESs in the Niraj - Târnava Mică region, we examined to what extent and in what quality certain parts of the landscape are able to provide specific services. We created models (**Fig. 7.3**) to describe the area's capacity to provide services (see **Fig. 7.1**, level 2). The different types of models, methods used, and the process of modelling are depicted in the following sections.

### 7.2.1 Definition and types of ES models

For a detailed landscape level spatial ES assessment, i.e. ES mapping, models are needed. Models link biophysical data spatially represented by input maps with variables (indicators) describing the capacity of the landscape to provide a certain ES. Models exist in defined levels of complexity called tiers (see details in text box). The approach used in this study complies with the EU recommendations by moving from simple to complex methods. Table 7.2 under *Chapter 7.3* summarizes the final models and maps for each ES, indicating the complexity level (tier) of each model.

**Tier 1: primary data**. The most simple models are compiled with local experts using the ES matrix approach (assigning values to certain land use/land cover classes, see 7.2.2 for details). Data is provided directly by stakeholders in the form of synthetic judgements. In rare cases data from previous surveys, environmental reporting streams or public statistics can also be directly used as indicators, however, in most cases primary data on meaningful ES indicators are too sparse to be used directly in assessments. This is a simple, well documented and flexible method widely used both in general and specific ES assessments (e.g. strategic environmental impact assessments or the planning phase of payment for ecosystem services schemes).

**Tier 2: rule-based, GIS or statistical models.** Beside (or instead of) the baseline expert matrix, predictions are made using a statistical model or a set of rules linking the value of the indicator to additional background variables which are available at the required spatial resolution and which can be assumed to determine (to a certain degree) or being correlated to the indicator.

**Tier 3: process-based** (or biophysical / mechanistic / agent-based) **models**. If the indicator in question is a component of a system of known internal mechanisms, and there is an appropriate process-based model for this system with all relevant input data and model parameters available, then it can be used to directly model indicators characterizing the studied service. During the project implementation period of Niraj-MAES we had no possibility to develop such models but we

documented each cases where such a need arose as further research ideas. This can be very useful for planning follow-up projects.

### 7.2.2 Matrix models

According to Jacobs et al. (2015), expert estimation of ES supply per land use or land cover (LULC) class, aka "the matrix model" is one of the most popular ES assessment techniques today (**Fig. 7.3***)*. MTA ÖK has already applied the model previously in a similar scale regional ES assessment in Hungary within the frames of the OpenNESS FP7 project (http://www.openness-project.eu/). The basic spatial input to the model is the ecosystem (base) map of the area, which displays the list of typical ecosystem / habitat / land cover and land use types previously defined during an iterative process. The actual model is a simple table (matrix) with the ecosystem types as rows and the ecosystem services as columns. There are several potential data sources to be used for the creation of matrix scores, e.g. empirical model results, biophysical indicators or expert estimations. In the Niraj-MAES project we applied the following approaches:

- scores based on the knowledge / evaluation of local experts (elicited in dedicated "matrix workshops" or during direct consultation)
- scores based on literature data

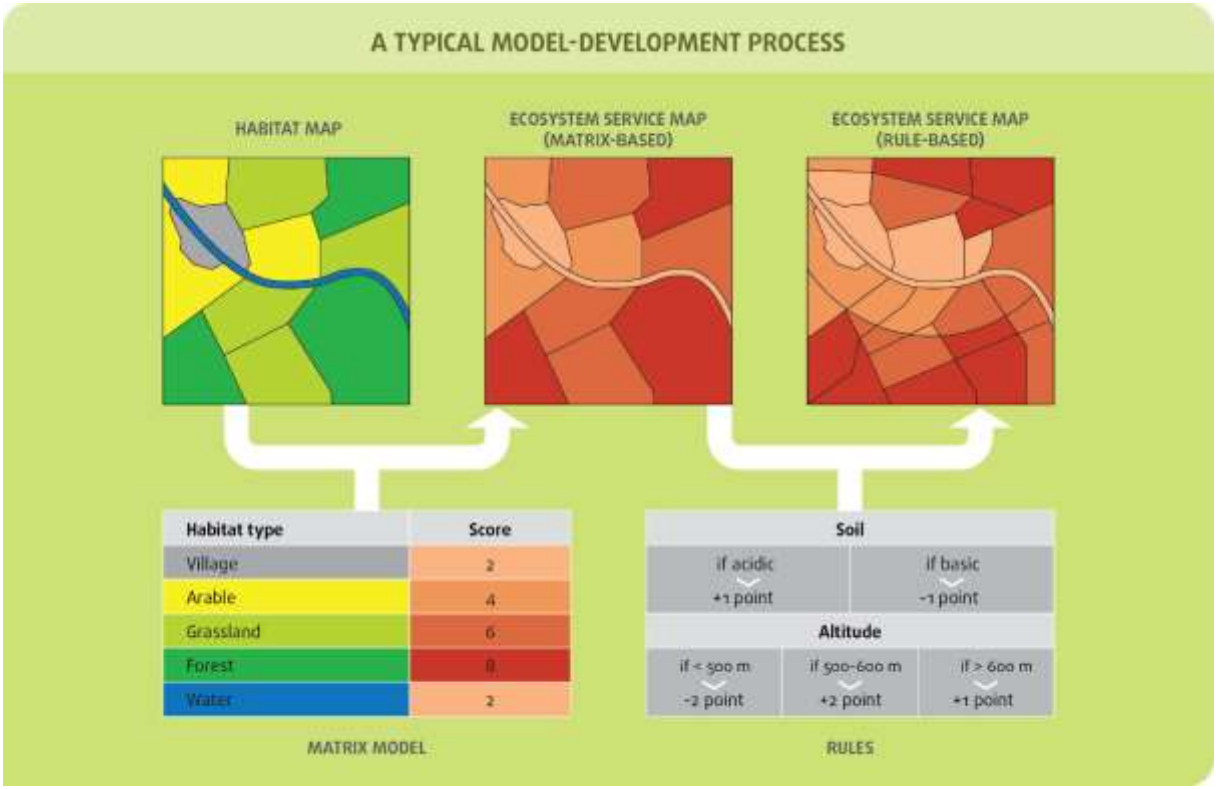


**Fig. 7.3:** Schematic concept of the ES matrix model (after Burkhard et al. 2009): using expert-based estimations, physical quantifications or empirical model results, ES supply capacities are attributed to land use/land cover (LULC) classes (ecosystem or habitat types). These might be further extended to rule based models (tier 2) including additional modifying features.

### 7.2.3 Rule-based models (enhanced matrix models)

During the matrix workshops (see 7.2.5), some matrix models were further developed by identifying additional input data (spatial predictors) which could improve the matrix scores, and thus upgrade model complexity to tier 2 level. Such models are called rule-based expert models. The following strategy was applied: matrix models were developed and validated for reliability during the matrix workshops. We used the workshop's opportunity to elicit expert knowledge on potential "rules" as well as their weights too, by which we could refine the matrix model in a structured form. In some cases, this was completed by subsequent individual expert consultations (e.g. honey, hay, wood). The basic input of rule-based models is, just as in Tier 1 models, the ecosystem (habitat) map, but the original model is completed with further biophysical or environmental variables as additional input data.

After assessing importance of the listed influencing factors and feasibility of fitting them into the models, quantification rules (in terms of ES-score adjustments) were formulated. Several decision support GIS systems are available for integrating spatial predictors to ES maps in a participatory context. We used the QUICKScan (QS) software (Verweij et al. 2016) based on MTA ÖK's previous favourable experiences with this tool. QUICKScan is a spatial modelling environment supporting: the assessment of societal and environmental conditions, diagnose patterns and interactions, implement alternative responses and, evaluate the impacts of those responses. It combines expert knowledge with spatial and statistical data. With QS several input maps (e.g. elevation, slope, etc) were brought together, base ES-scores weighed and modified according to defined rules and further inputs. Final rules of each models are described in detail under *Chapter 7.3*. The final maps were produced in R (with add-on packages sp (Pebesma & Bivand, 2005), rgdal (Bivand et al. 2016), and raster (Hijmans, 2016)), replicating the structure of the Quickscan models.

### 7.2.4 Statistical models

Statistical models establish a correlative (statistical) relationship between a phenomenon of interest (e.g. the supply of an ES) and some readily available and presumably related predictor variables. The phenomenon of interest is known only from a few locations, whereas the predictors are known for the whole study area. In such cases the statistical relationship captured by the model can be used to estimate the phenomenon of interest in the unsurveyed parts of the study area, as well. There are many types of potential statistical relationships, and consequently many types of applicable statistical model types, too. In case of the ecosystem condition indicator habitat naturalness, for example, we applied Elastic-Net Regularized Generalized Linear Models with an elastic net penalty of 0.5 (*glmnet* package in R, Friedman et al. 2010) in order to establish statistical relationships between the occurrence of bird species and many environmental predictors. Landscape diversity, on the other hand was assessed by a completely different approach: a landscape index, which captures relevant characteristics of a landscape by doing calculations on the map (Shannon diversity of the habitat types within a moving window, Shannon 1948).

### 7.2.5 Expert knowledge elicitation methods

While tier 3 models need much more detailed data and information about the underlying processes, knowledge sources for tier 1 and tier 2 models are often simpler. In the following section we will introduce some of the methods for eliciting expert knowledge that we used for obtaining data as input to our models.

***Matrix workshops***

The majority of ES models created during the project were developed through an iterative participatory process with the involvement of local experts called 'matrix workshops', aiming to document local expert estimations on ES capacities in a standardized manner. After considering the interview results and SAB recommendations, six ES were selected and modelled this way: honey, timber, hay, gathered wild plants, tourism and soil erosion.

Two half-day matrix workshops were organized, each discussing three ES. Small expert groups were formed with three-four experts per ES. The groups developed simple tier 1 models by assigning relative scores between 1-10 for each matrix cell, referring to the estimated capacity of each ecosystem type to perform each ES respectively. In case of some ES, sub-categories of ecosystem types and influencing factors were identified so that more precise maps corresponding to tier 2 could be created. Some scores were fine tuned after the workshop, based on additional expert consultations, the SAB, and/or literature data. See detailed outline of the matrix workshop in Text box "Outline of a matrix workshop".

**Outline of a matrix workshop**

Small expert groups of 3-4 participants and a facilitator (project team member) formed

Short explanation of the ES context and the actual exercise

Get familiar with the base map

Assigning 1-10 scores to estimate capacities of the 12 predefined ecosystem types to supply the particular ES discussed by the group

When scoring, focus on the project area only

Start with fixing the lowest (score 1) and highest (score 10) capacity ecosystem type, then score all the rest

If the ES capacity of a certain habitat type is variable, score ranges can be given and the group may define habitat sub-categories

Besides habitat types, additional spatial variables are defined to better capture the ES capacity

After assigning scores to all habitats occurring in the study area, the group named a 'best habitat' at whole Romanian scale and scored that too without upper limit for the score, so that the 1-10 local scale is embedded into Romanian context

The final step is fixing the relative scale by assigning concrete measurement numbers and units to the scores (where possible)

New expert groups are formed to validate the results and recommend revision of any disputed results

Results are presented at the plenary in Quickscan GIS environment, disputed results discussed to reach consensus

The whole process is documented in detail and sound recorded

***Direct consultation***

Direct consultation with few carefully selected experts can be a very good option to elicit expertise in highly technical cases, where the pool of available experts is very limited (e.g. in complex but deterministic biophysical domains, like soil science or water engineering). This strategy can be used to assign scores to a matrix model (tier 1), or for upgrading a matrix model to a rule-based (tier 2) model. For example, soil fertility data were based on expert knowledge elicited during two direct consultations.

***Literature data***

In some cases data from literature was used either to refine models and to make a transformation from expert assigned scores into real biophysical units possible (e.g. timber), or to compile a basic tier 1 model. For example, the capacities for carbon sequestration were estimated using methodologies suggested by the IPCC for tier 1 (IPCC 2003) following their application for the relevant categories as shown in the Romanian National Greenhouse Gas Inventory from 2013 (Ministry of Environment and Climate Change 2013).

***The role of the Stakeholder Advisory Board (SAB)***

The Stakeholder Advisory Board (SAB) of the research project exerted a supervisory role in the case of all of the models that were developed with transparent modelling techniques (all matrix models and the rule-based models). Therefore, the models developed as described above and the resulting maps were presented at the 3rd SAB meeting for consultation and approval. Recommendations received from the SAB members were, after evaluating their feasibility, built into the model QS algorithms so that the final models were achieved.

Final models and maps are discussed in *Chapter 7.3*, and partly also in *Chapter 8*.

## 7.3 Final models and maps

This chapter will overview how the above described modelling toolkit was applied and final maps created during the project for each EC and ES. The following information is provided for each model: model type, tier level, input data (matrix scores and/or additional variables, additional input maps where applicable, calibration data of statistical models), level of expert involvement and the final map. See summary of the ES-models with the used input data in Table 7.2, and summary of the final scores used as input for the matrix models in Table 7.3.

**Table 7.2:** Overview of the ES-models with the used input data.

| ES/EC indicator | model type | model level (tier) | input data | experts involved |
|---|---|---|---|---|
| habitat naturalness | statistical | 2 | habitat map + elevation + steepness + aspect + soil type (fertility) + distance from roads + distance from water + Landsat + ecological status | dedicated expert workshop |
| landscape diversity | matrix | 2 | habitat map (transformed) | workshop |
| soil fertility | matrix | 2 | elevation + steepness + soil type (fertility) | individual consultations |
| wood and timber | matrix | 2 | habitat map + elevation + steepness | workshop |
| natural forage and fodder | matrix | 2 | habitat map + naturalness + elevation + steepness + soil type (pH) | workshop |
| wild plants and mushrooms | matrix | 2 | habitat map + naturalness + soil type (pH) + soil type (texture) + grazing intensity | workshop |
| honey | matrix | 2 | habitat map + naturalness + landscape diversity + soil fertility + elevation + grazing intensity | workshop |
| water retention | matrix | 2 | habitat map + steepness + grazing intensity | workshop |
| carbon sequestration | matrix | 1 | habitat map | literature |
| touristic attractiveness | matrix | 2 | habitat map + naturalness + landscape diversity + elevation + distance from roads + distance from water | workshop |

**Table 7.3:** Overview of the final scores used as input for the matrix models (matrix values for wood and timber capacities were structured in a different way, and are presented in **Table 7.5**.

| ecosystem type | natural forage and fodder | wild plants and mushrooms | | | honey | water retention | touristic attractive-ness |
|---|---|---|---|---|---|---|---|
| | | mush-rooms | medical herbs | wild edible plants | | | |
| settlement | 3 | 6 | 6 | 6 | 3 | 0 | 9 |
| intensive agricultural | 2 | 1 | 1 | 1 | 2 | 4 | 2 |
| extensive agricultural | 5 | 6 | 6 | 6 | 3 | 7 | 7 |
| pasture | 9 | 9 | 9 | 9 | 4 | 6 | 6 |
| hay meadow | 9 | 9 | 9 | 9 | 6 | 10 | 6 |
| encroached grassland | 5 | 9 | 9 | 9 | 6 | 7 | 4 |
| wood pasture | 8 | 10 | 10 | 10 | 4 | 7 | 9 |
| orchard | 7 | 7 | 7 | 7 | 7 | 9 | 8 |
| tree group | 6 | 7 | 7 | 7 | 7 | 9 | 7 |
| pine and spruce forest | 1 | 9 | 5 | 4 | 2 | 10 | 7 |
| robinia forest | 2 | 3 | 4 | 1 | 10 | 9 | 5 |
| broad-leaved forest | 2 | 10 | 5 | 6 | 3 | 10 | 10 |
| water | 3 | 2 | 5 | 5 | 4 | 8 | 9 |

### 7.3.1 Wood and timber

| | |
|---|---|
| Definition: | Long-term timber and firewood provisioning potential of the habitat, assessed as a yearly average considering the whole lifecycle of the habitat, not taking effects of climate change into account. |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | extended matrix (Tier 2 model based on technical literature (forestry production tables, 'Tabele de producție', Giurgiu et al. 2004) |
| Input data: | ecosystem map, elevation, slope steepness, tree species + forestry production data |
| Rules in extended model: | elevation<br>• different rule for each major forest species, see **Table 7.5**<br>slope steepness [all forest types]<br>• steep (>17.5° mean slope): +1 (adjustment towards a less productive *production class*!) |
| Level of expert involvement: | matrix workshop, SAB, individual expert consultations |
| Final map: | colour codes show the ES supply capacity of the area in $m^3ha^{-1}yr^{-1}$ (**Fig. 7.4**) |

Wood and timber constitute key products of natural ecosystems in the study area. As we had no access to regional estimations of standing wood volumes, capacities for wood and timber provision were estimated with the help of the rule-based model co-developed with local experts (foresters). Furthermore, as most of the data available pertain to the forest areas handled by the Romanian national Forest Land Fund (FLF, e.g. INS 2015), we excluded non-FLF forests from the monetary valuation. As in Romania the proportion of non-FLF forests is relatively high (7%), this results in an underestimation of both the capacities and the actual use, especially considering the subsistence use of fuelwood and timber. However, most of the products that are marketed, are based on timber and fuelwood from the FLF areas. It is only 78% of the habitats identified as forests on our habitat map (based on satellite images) that actually belong to the FLF system.

To estimate the total timber provisioning capacities we started out from our habitat map. We determined the typical tree species composition for each of the forested habitat types of the region (**Table 7.4**). Capacities of typically non-FLF habitat types (orchards, forest pastures, encroached grasslands, and rows of trees) were not taken into account in the capacity valuation.

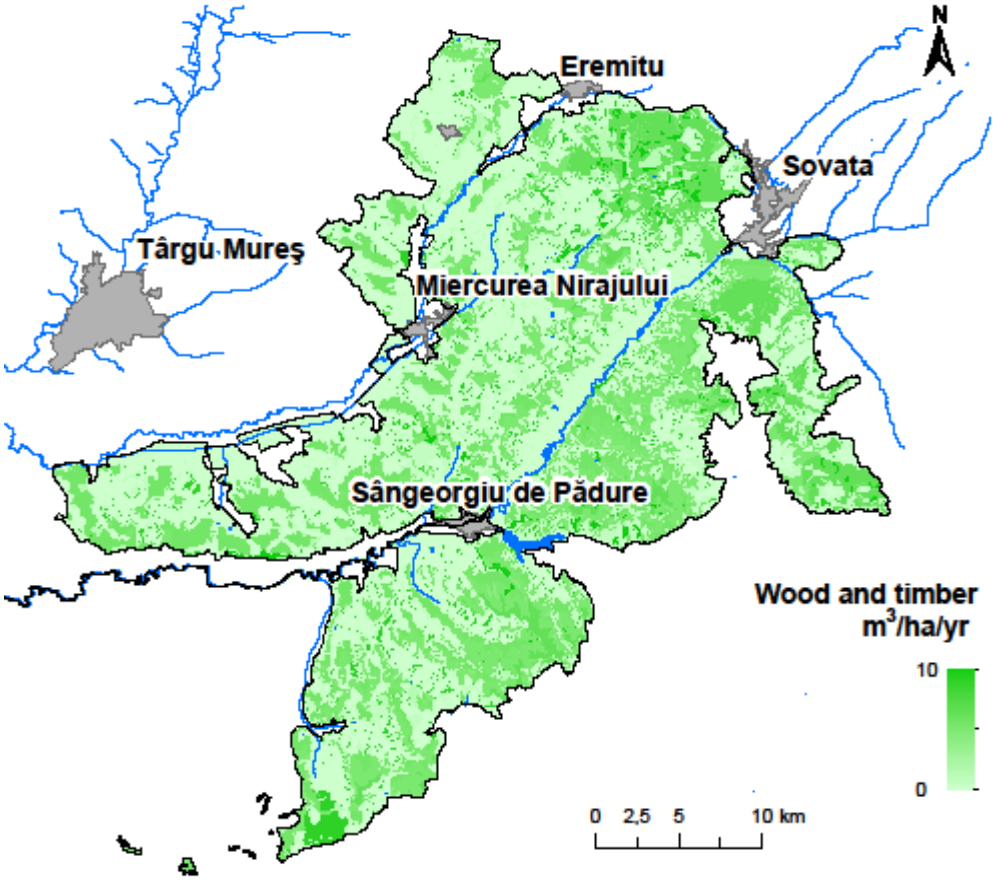


**Fig. 7.4:** The landscape's long-term capacity to provide wood and timber

**Table 7.4:** Typical species composition of the most important forest types in the Niraj -Târnava Mică region

| | *Fagus sylvatica* | *Quercus petraea* | *Carpinus betulus* | *Picea abies* | *Pinus species* | *Robinia pseudoacacia* |
|---|---|---|---|---|---|---|
| broad-leaved (<500 m a.s.l.) | 35% | 33% | 22% | | | |
| broad-leaved (500-600 m a.s.l.) | 44% | 29% | 17% | | | |
| broad-leaved (>600 m a.s.l.) | 78% | 5% | 7% | | | |
| pine and spruce forest | | | | 69% | 21% | |
| Robinia forest | | | | | | 90% |

At the matrix workshop the experts assigned typical production classes ('clase de producție') to each major forest tree species of the region, and proposed adjustment rules for the relevant environmental factors (elevation and slope steepness). In addition, the experts also estimated sustainable annual timber and fuelwood yields (in $m^3ha^{-1}y^{-1}$) for several non-forested habitat types that are known to be actively used by locals (encroached grasslands, wood pastures, and orchards). Following the recommendations of the experts, we divided the whole study area into three zones according to elevation (low: <500, medium: 500-600, high: >600 m a.s.l.), and to slope steepness (flat/steep,

below/above the (threshold) value of 17.5° mean slope, calculated over 1 ha). We then calculated the "area" of each major tree species for each combination of elevation and steepness zone. To estimate the long term average annual yields for each species and forest type we resorted to literature data from the official production tables ("Tabele de producție", Giurgiu et al. 2004) used for planning in the Romanian forestry sector. We assigned a production class ("clase de productie relative") to each tree species in each zone with the help of local experts, and looked up the optimal harvest age (i.e. the length of the typical management cycle) as well as the corresponding wood yields from the production tables (**Table 7.5**).

**Table 7.5:** Relative production classes (class) as expert scores for each major tree species in the different altitude and steepness zones. Optimal harvest age (age), and the amount of average annual production in $m^3ha^{-1}y^{-1}$ was determined using the official production tables of the Romanian forestry administration.

| **Species** | **Class** | **Age** | **Production** | **Zone description** |
|---|---|---|---|---|
| *Fagus sylvatica* | II | 120 | 5.8 | above 600m on flat land |
| | III | 120 | 4.7 | elsewhere |
| | IV | 120 | 3.6 | below 600m on steep slopes |
| *Quercus petraea* | II | 120 | 5.2 | below 500m on flat land |
| | III | 120 | 4.2 | elsewhere |
| | IV | 120 | 3.1 | above 500m on steep slopes |
| *Carpinus betulus* | III | 70 | 4.0 | on flat land |
| | IV | 70 | 3.4 | on steep slopes |
| *Picea abies* | II | 70 | 10.9 | on flat land |
| | III | 70 | 9.4 | on steep slopes |
| *Pinus* spp | III | 60 | 5.5 | everywhere |
| *Robinia pseudoacacia* | II | 40 | 10.8 | on flat land |
| | III | 40 | 8.2 | on steep slopes |
| encroached grasslands | -- | -- | 0.5 | everywhere |
| wood pastures | -- | -- | 1.0 | everywhere |
| orchards | -- | -- | 0.5 | everywhere |

### 7.3.2 Natural forage and fodder

| | |
|---|---|
| Definition: | Potential forage supply provided by the ecosystems through mowing or grazing. Cultivated or marketed roughage and grain feed are not included while grazing on fallow land and stubble as well as plants spontaneously occurring on waysides and banks are included in this service. |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | extended matrix (Tier 2 rule-based model) |
| Input data: | ecosystem map, soil type (pH), elevation, steepness, naturalness, grazing intensity |
| Rules in extended model: | soil type<br>• acidic: -2<br>• strongly acidic: -4<br>elevation<br>• 500-850 m: +2<br>slope steepness<br>• steep (11-27°): -1<br>• very steep (>27°): -2<br>habitat naturalness<br>• lower tertile: -1<br>• upper tertile: +1<br>grazing intensity [pastures, wood pastures]<br>• high: -1<br>• very high: -2 |
| Level of expert involvement: | matrix workshop, SAB |
| Final map: | colour codes 1-10 show the relative ES supply capacity of the area from lowest (1) to highest (10) level (**Fig. 7.5**) |

Natural forage and fodder is one of the most important ESs present in local economy, especially in a historical context. Despite the relatively low score it obtained in the preference assessment (see *Chapter 6*) SAB asked us to retain this ES among the ones chosen for mapping and assessment.

The capacities of the different habitat types to support grazing livestock by natural fodder either by grazing or through hay production was assessed by local experts (practicing farmers, agricultural administration experts, head of commonage) during the matrix workshop. The workshop participants also identified further influential factors which determine the capacity of grasslands, and proposed simple adjustment rules, which were implemented in QuickScan and R later. Interestingly, grazing intensity was also suggested to be taken into account in the estimation of the capacities, thus acknowledging the possible negative impacts of overgrazing on long term capacities. The local experts also proposed an indicative transformation of the scores into absolute values in fodder units (FU, Brüggemann et al. 1959). However, due to the uncertainties of the input maps (habitats and soil) and

the serious ambiguities in the fodder unit approach itself, we did not use FU's as a basis for cartographic representations or economic valuation for this ES (see also *Chapter 8*).

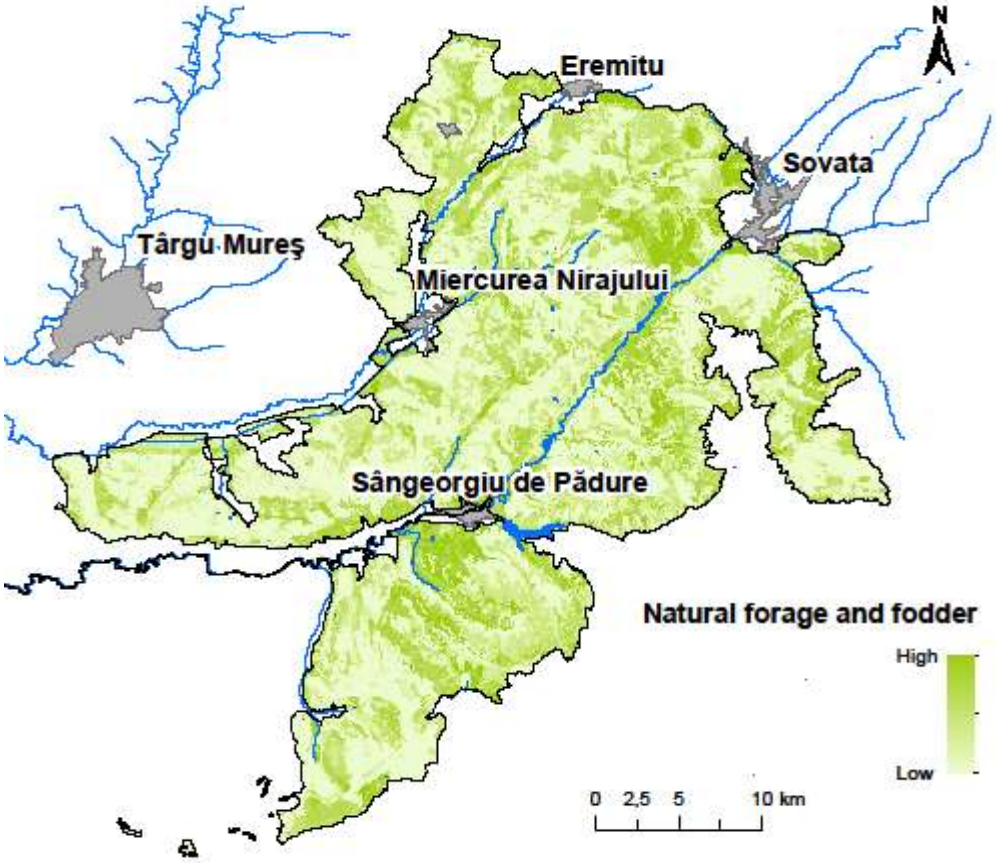


**Fig. 7.5:** The landscape's capacity to provide natural forage and fodder for domestic animals.

### 7.3.3 Wild plants and mushrooms

| | |
|---|---|
| Definition: | Gathered mushrooms, fruits, berries and medicinal herbs provided spontaneously by the habitat. Cultivated plants and mushrooms are not included. |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | extended matrix model (a Tier 2 approach based on the aggregation of 3 rule-based sub-models -- one for each component: wild edible plants, mushrooms, and medicinal plants)) |
| Input data: | ecosystem map, soil type (pH, texture), grazing intensity, habitat naturalness |
| Rules in extended model: | soil type<br>• high clay: -1 [medicinal]<br>• acidic: +1 [mushrooms]<br>grazing intensity [pastures, wood pastures]<br>• high: -1 [medicinal, berry]<br>• very high: -2 [medicinal, berry]<br>habitat naturalness<br>• lower tertile: -1<br>• upper tertile: +1 |
| Level of expert involvement: | matrix workshop, SAB, expert consultations |
| Final map (aggregated for herbs, mushrooms and berries): | colour codes 1-10 show the relative ES supply capacity of the area from lowest (1) to highest (10) level (**Fig. 7.6**) |

The ES “wild plants and mushrooms” is actually an umbrella term covering many different goods supplied by nature, which share certain characteristics: they are collected from the wild, which needs some expertise, and they are either used for the collectors own consumption or targeted for specialized markets. Essentially all of these goods (species and species parts collected) can be seen as different services, with no trivial “common metric”, meaning that 1 kg of one good (e.g. truffles) is not equal to the same amount of the other (e.g. stinging nettles). There was no possibility to convert the scores from the local experts’ workshop on the capacity of the different habitat types to supply with these goods to real biophysical quantities. This was due to their variety as well as due to the lack of knowledge on the average amounts of plants/fruits that grow per hectare in the area. Therefore, final maps show relative scores of capacity based on expert assessments.

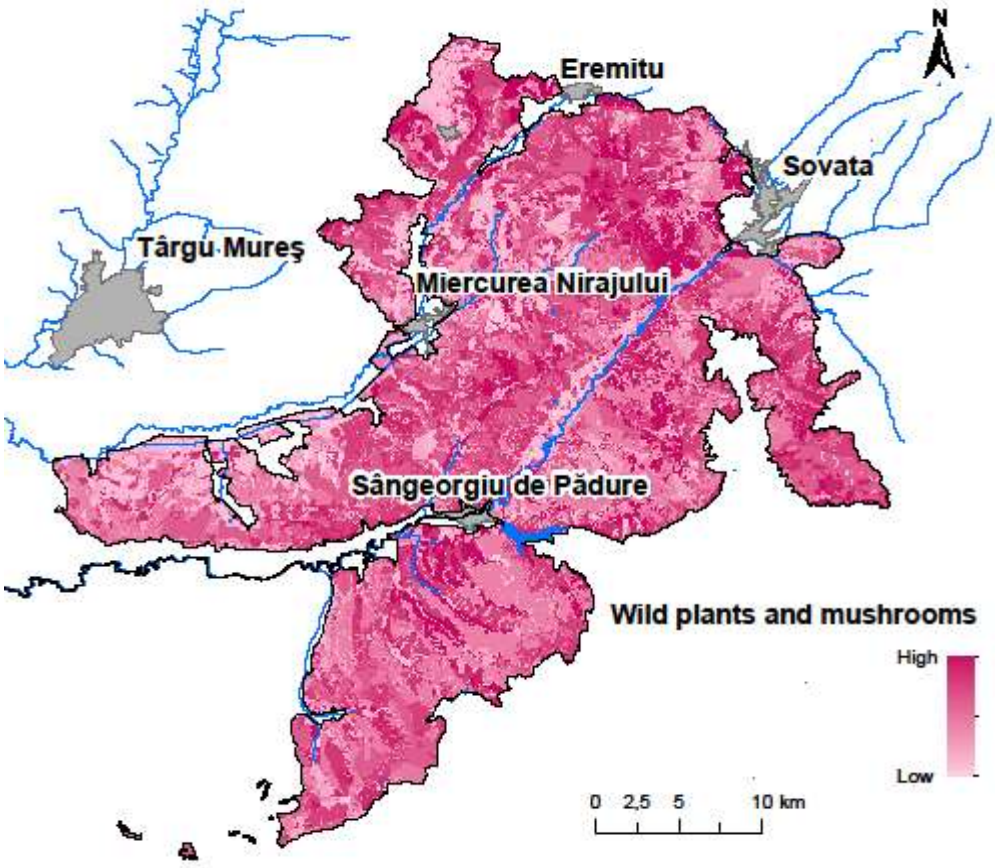


**Fig. 7.6:** The landscape's capacity to provide wild edible mushrooms, berries and medicinal herbs

### 7.3.4 Honey and nectar

| | |
|---|---|
| Definition: | Potential of the habitat to supply nectar and pollen for honeybees and so contribute to honey production. |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | extended matrix (Tier 2 rule-based model) |
| Input data: | ecosystem map, soil fertility, naturalness, landscape diversity, elevation, grazing intensity + farm data and literature data on honey production |
| Rules in extended model | elevation<br>• >500 m: +0.5<br>soil fertility [intensive and extensive agricultural]<br>• low soil fertility: -0.5<br>• high soil fertility: +0.5<br>habitat naturalness<br>• lower tertile: -0.5<br>• upper tertile: +0.5<br>landscape diversity<br>• lower tertile: -0.5<br>• upper tertile: +0.5<br>grazing intensity [pastures, wood pastures]<br>• high: -0.5<br>• very high: -1 |
| Level of expert involvement: | matrix workshop, SAB, individual expert consultations |
| Final map: | colour codes show the nectar (bee pasture) provisioning capacity of the area in a kg honey per hectare per year scale (**Fig. 7.7**) |

According to our conceptual framework of ecosystem services, we considered as 'yields' only the 'net natural yields' of honey, which we define as the yields that can be achieved without external feeding of the colonies. Honey providing capacities were estimated with the help of the rule-based model co-developed with local experts during the matrix workshop. The experts (practicing beekeepers) participating at the matrix workshop also identified several influencing factors, which served as the basis for defining adjustment rules acknowledging the effects of these factors. To get a regional valuation of honey provisioning capacities, the ordinal-scale scores from the rule-based model were linearly transformed into real biophysical values based on two fitting points (**Table 7.6**) identified by individual expert consultations and literature values. Capacity scores lower than five were considered to be insufficient to produce yield or even to sustain bee colonies (starving bees), thus these scores were replaced by 0 (beekeeping is not economical there). Due to the dominance of low and middle-scored habitat types in the region, we could only perform calibration for a combination of two particularly widespread habitat types (pastures and hay meadows) with the help of a local beekeeper

who keeps 40 families all year long in a landscape dominated by these habitat types. For the most productive bee foraging habitats (*Robinia pseudoacacia* forests and *Phacelia* fields) such a calibration was not possible, here we applied data from the literature after some corrections (**Table 7.6**).

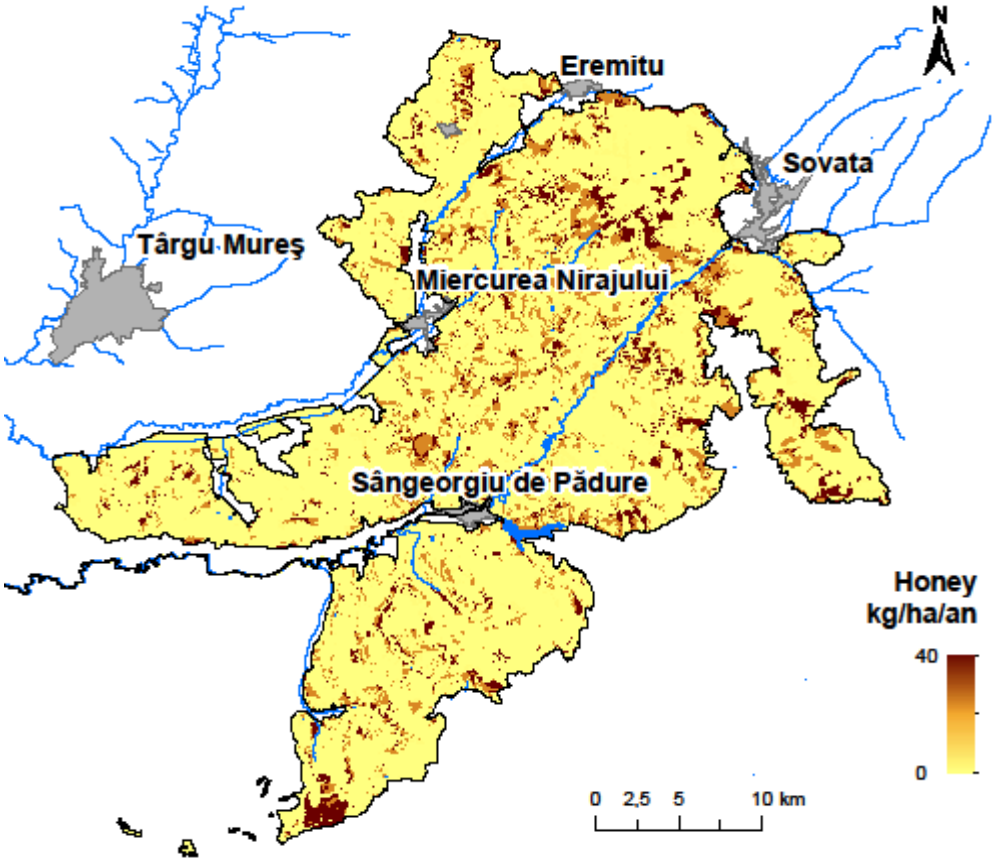


**Fig. 7.7:** The landscape's capacity to provide source of bee pasture and honey production

**Table 7.6:** Fitting points for converting nectar provision capacity scores into honey yields

| Score | Yield (kg/ha/yr) | Source |
|---|---|---|
| 5 | 0.41 | Calibration by production data from a local beekeeper |
| 10 | 40 | Based on expert consultations. The theoretical maximum nectar yield of robinia forests (800-1600 kg/ha/yr, Halmágyi & Keresztesi 1991, Nyárádi 1958), was severely reduced in order to correct for<br>• the relatively unfavourable environmental conditions of the region for Robinia (compared to other regions of Romania)<br>• the big annual variances in Robinia nectar production in the region (the average year is much below an optimal year)<br>• and the amount of honey that the high number of bee colonies that is required in order to be able to harvest the maximum yield during the short flowering period (3-4 colonies/ha) would consume throughout the rest of the year in order to survive (50-100 kg honey/colony) |

To turn all honey capacity scores into production values, we fitted a linear model to the two points (**Table 7.7**). The capacity maps express these transformed production values in terms of yield (kg) per year and area (ha).

**Table 7.7:** Yield values assigned to the different expert scores used for calculating honey provisioning capacity

| Score | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Yield (kg/ha/yr) | 0 | 0 | 0 | 0 | 0.4 | 8.3 | 16.2 | 24.2 | 32.1 | 40.0 |

### 7.3.5 Water retention and erosion control

| | |
|---|---|
| Definition: | Contribution of the land cover to slowing down the passage of surface water and thus to the recharge of regional groundwater resources and the mitigation of soil erosion. |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | (1) matrix model (a Tier 1 model based on expert scores and a habitat map), (2) extended matrix (a Tier 2 rule-based model) |
| Input data: | ecosystem map, slope steepness |
| Rules in extended model | grazing intensity [pastures, wood pastures]<br>• high: -1<br>• very high: -2<br>slope steepness [*multiplicative adjustment!*]<br>• flat (<11°): 20% of the original score<br>• moderately steep (11-27°): 60% of the original score |
| Level of expert involvement: | matrix workshop, SAB |
| Final map: | colour codes 1-10 show the relative ES supply capacity of the area from lowest (1) to highest (10) level (**Fig. 7.8**) |

Even though water retention and erosion control were mentioned separately during the interviews, and were introduced as distinct services into the prioritization process, they were later combined, and mapped with the same joint ES indicator. The reason for this decision is that the underlying mechanisms (the deceleration of runoff and increase of infiltration), and thus also the key system properties that determine the capacity of ecosystems for these two closely related ES are basically the same. Both ESs depend strongly on the land surface cover and its temporal dynamics, which can be well expressed by our ecosystem map (Pimentel et al. 1995, Gajic et al. 2008).

The quality (roughness, leaf area, permeability, etc.) of the land surface influences surface runoff and soil water retention. Additional factors widely used for calculating/predicting potential soil erosion (Le Bissonnais et al. 2002, Gajic 2008) like soil compaction, different soil types, rainfall erosivity, slope length or soil erodibility could not be taken into account as data were not available at an appropriate regional level. As calculating exact amounts of reduced soil erosion in relation to the actual vegetation cover and the geographic properties of the specific point (pixel) in the study area was not feasible, we relied for the mapping of this service on the expert estimates on the potential of vegetation cover to reduce soil erosion and included grazing pressure (as high grazing rates enhance erosion) and slope as a factor which varied the effective capacity of vegetation to mitigate erosion (the steeper the stronger the effect of vegetation).

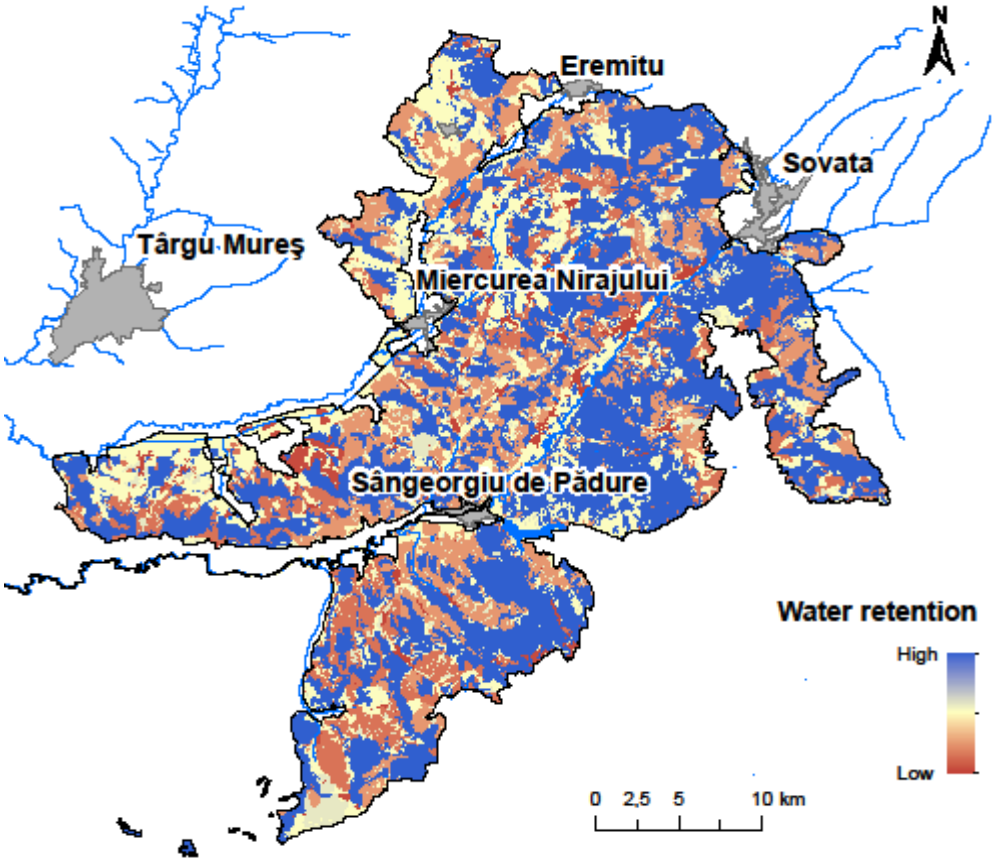


**Fig. 7.8:** Capacity of ecosystems to slow surface water runoff, and thus contribute to the recharge of regional groundwater resources and mitigate soil erosion.

### 7.3.6 Carbon sequestration (climate change mitigation)

| | |
|---|---|
| Definition: | Sequestration and storage of atmospheric carbon by the habitat, as contribution to global climate change mitigation. |
| Cascade level: | 2 (ecosystem service capacity) and 3 (ES actual use) |
| Modelling approach: | Tier 1 IPCC model (adapting a Tier 1 IPCC national greenhouse gas inventory model to the Niraj-MAES area) |
| Input data: | ecosystem map + literature data (IPCC 2003, Ministry of Environment and Climate Change 2013) |
| Level of expert involvement: | No direct involvement of experts, but following expert guidance from literature |
| Final map: | colour codes 1-10 show the relative ES supply capacity of the area from lowest (1) to highest (10) level (**Fig. 7.9**) |

In the case of carbon sequestration, we used a tier1 IPCC greenhouse gas inventory approach. We adapted the methodology to the slightly more detailed habitat types of our habitat map.

As a first step we defined which categories of our habitat map correspond to which IPCC categories, on which the IPPC Good Practice Guide (IPCC 2003) is based on (see **Table 7.8**). With these categories, we followed the calculations described by the Romanian National Greenhouse Gas Inventory (Ministry of Environment and Climate Change 2013), assigning each habitat category a characteristic carbon-sequestration value. For croplands (orchards, encroached grasslands) these were constant values, whereas for the forests harvest data from Mureș county (INS 2016) was the base for the calculations (**Table 7.9**).

Carbon sequestration, similarly to a few other regulating services not assessed in this study, is "used" without conscious human involvement, which is why actual use can be considered equivalent to capacity.

**Table 7.8:** Correspondence of habitat map categories with IPCC categories.

| **short name** | **IPCC category** | **net $CO_2$ change (gain-loss) (tonnes $ha^{-1}$ $yr^{-1}$)** |
|---|---|---|
| settlement | Settlements: Construction + Roads/Railways | |
| intensive agricultural | Cropland: Arable | |
| extensive agricultural | Cropland: Arable | |
| pasture | Grassland: Pastures + Hayfields; | |
| hay meadow | Grassland: Pastures + Hayfields; | |
| encroached grassland | Cropland: revegetated | 14.4 |
| wood pasture | Grassland: Pastures + Hayfields; | |
| orchard | Cropland: Vineyards + Orchards; | 7.7 |
| tree group | Forestland | |
| pine and spruce forest | Forestland | 5.8 |
| robinia forest | Forestland | 7.2 |
| broad-leaved forest | Forestland | 6 |
| water | Wetlands: Waters/ponds; | |

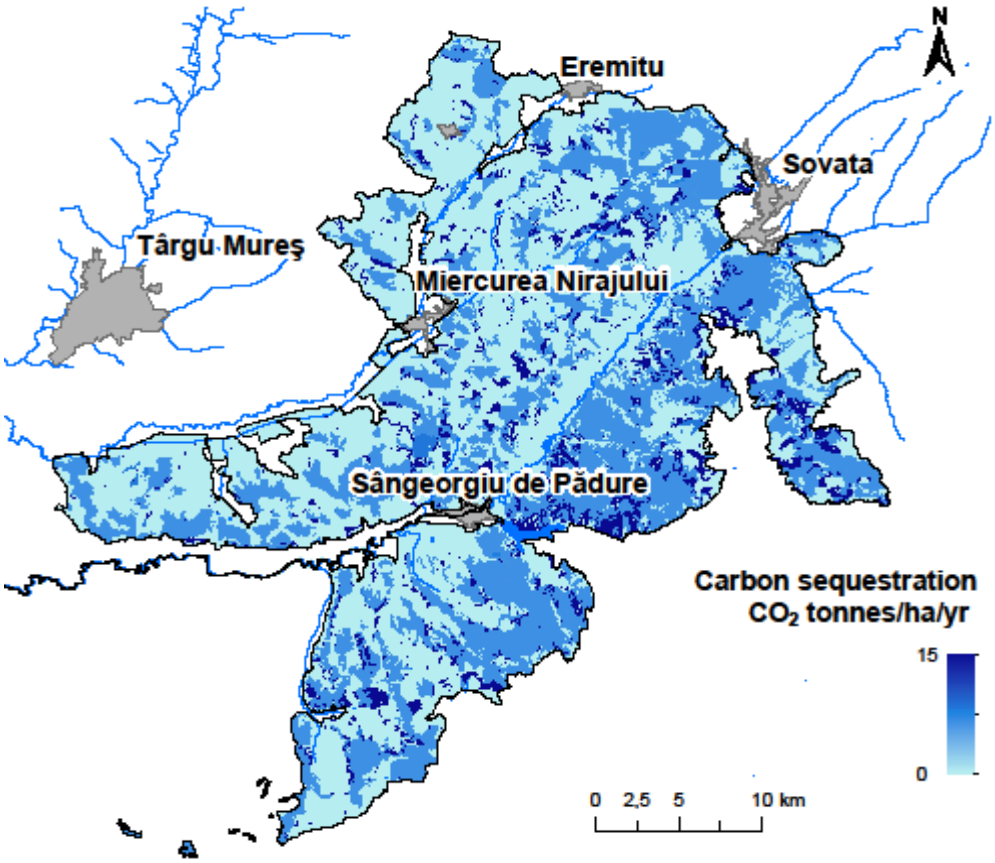


**Fig. 7.9:** The landscape's contribution to carbon sequestration and thus to global climate change mitigation.

**Table 7.9:** Net $CO_2$ sequestration gains, losses and net change (gain-loss) for the whole Niraj - Târnava Mică region, calculated on the basis of IPCC methodology

| | | | | **$CO_2$ gain (tonnes year$^{-1}$)** | **$CO_2$ loss (tonnes year$^{-1}$)** | **net $CO_2$ change (tonnes year$^{-1}$)** |
|---|---|---|---|---|---|---|
| CROPLAND | Living biomass | Above ground | woody (vineyards +orchards) | 2 816 | - | 2 816 |
| | | | revegetated (encroached grassland) | 53 242 | - | 53 242 |
| | | Below-ground | | - | - | - |
| | | DOM (deadwood+litter) | | - | - | - |
| | | soil | revegetated (encroached grassland) | 47 129 | | 47 129 |
| | **TOTAL CROPLAND** | | | **103 187** | **-** | **103 187** |
| | | | | | | |
| FORESTS | Living biomass | Above-ground + below-ground | | 282 906 | 139 189 | 143 717 |
| | | DOM (deadwood+litter) | | - | - | - |
| | | soil | | - | - | - |
| | **TOTAL FORESTS** | | | **282 906** | **139 189** | **143 717** |

### 7.3.7 Touristic attractiveness and local identity

| | |
|---|---|
| Definition: | Contribution of the habitat to the touristic attraction value of the area. Habitats allow recreation and create emotional bond in local people |
| Cascade level: | 2 (ecosystem service capacity) |
| Modelling approach: | extended matrix (Tier 2 rule-based model) |
| Input data: | ecosystem map, elevation, distance from water, distance from roads, habitat naturalness, landscape diversity |
| Rules in extended model | elevation<br>• >800 m: +1<br>habitat naturalness<br>• lower tertile: -1<br>• upper tertile: +1<br>landscape diversity<br>• lower quintile the original score, then +1, +2, +3, +4 respectively<br>distance from roads (accessibility)<br>• 200-500 m: -1<br>• 500-1000 m: -2<br>• 1000-2000 m: -3<br>• >2000 m: -4<br>distance from water<br>• >100 m: +8<br>• 100-200 m: +6<br>• 200-500 m: +4<br>• 500-1000 m: +2 |
| Level of expert involvement: | matrix workshop, SAB, individual expert consultations |
| Final map: | colour codes 1-10 show the relative ES supply capacity of the area from lowest (1) to highest (10) level (**Fig. 7.10**) |

Touristic attractiveness as an ecosystem service is defined as the contribution of the habitats to human recreation by which it is attractive for visitors. The same landscape features that enable the landscape to attract tourists can also create an emotional bond in local people (local identity). This is a closely related ecosystem service, which was considered extremely important by the locals during the preference assessment (*Chapter 6*). The capacities of the different ecosystem types to generate tourism and local identity was assessed by local experts (tourism entrepreneurs, regional tourism officers) during the matrix workshop. The workshop participants also identified further environmental factors which influence the contribution of landscapes to touristic attractiveness, and proposed simple adjustment rules, which were reviewed by the SAB, and then implemented in QuickScan and R later.

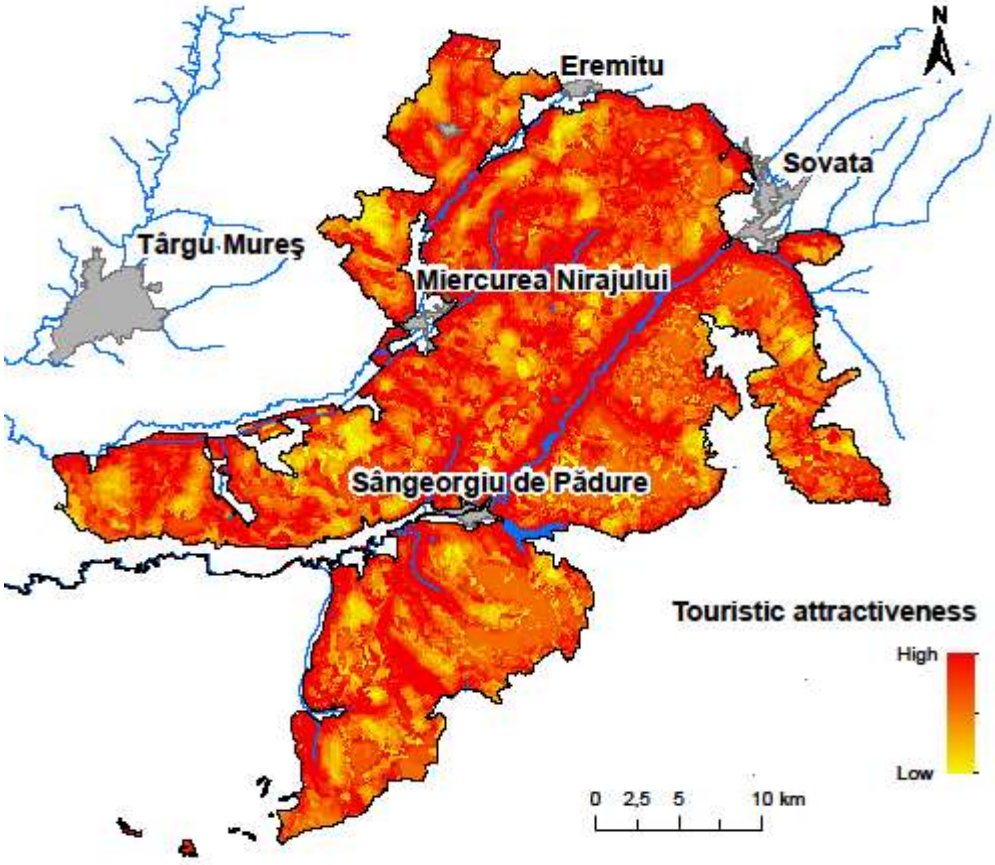


**Fig. 7.10:** The landscape's contributions to touristic attractiveness and sense of place

### 7.3.8 Habitat naturalness

| | |
|---|---|
| Definition: | The naturalness (incl. biodiversity and resilience) of the habitat. This ecosystem state influences the provision of several ecosystem services within and beyond the ones studied in this project, e.g. pest control, disease control, pollination. |
| Cascade level: | 1 (ecosystem condition) |
| Modelling approach: | statistical model (a Tier 2 index based on the modelled occurrence probabilities of bird species of conservation significance) |
| Input data: | ecosystem map, soil type, slope, elevation, aspect, distance from roads, distance from water, Landsat 8 reflectance values, water ecological status (primary data) + bird census data |
| Level of expert involvement: | expert workshop, individual expert consultations |
| Final map: | colour codes 1-10 show relative naturalness values (the capacity of locations to maintain biological diversity) from lowest (1) to highest (10) level (**Fig. 7.11**) |

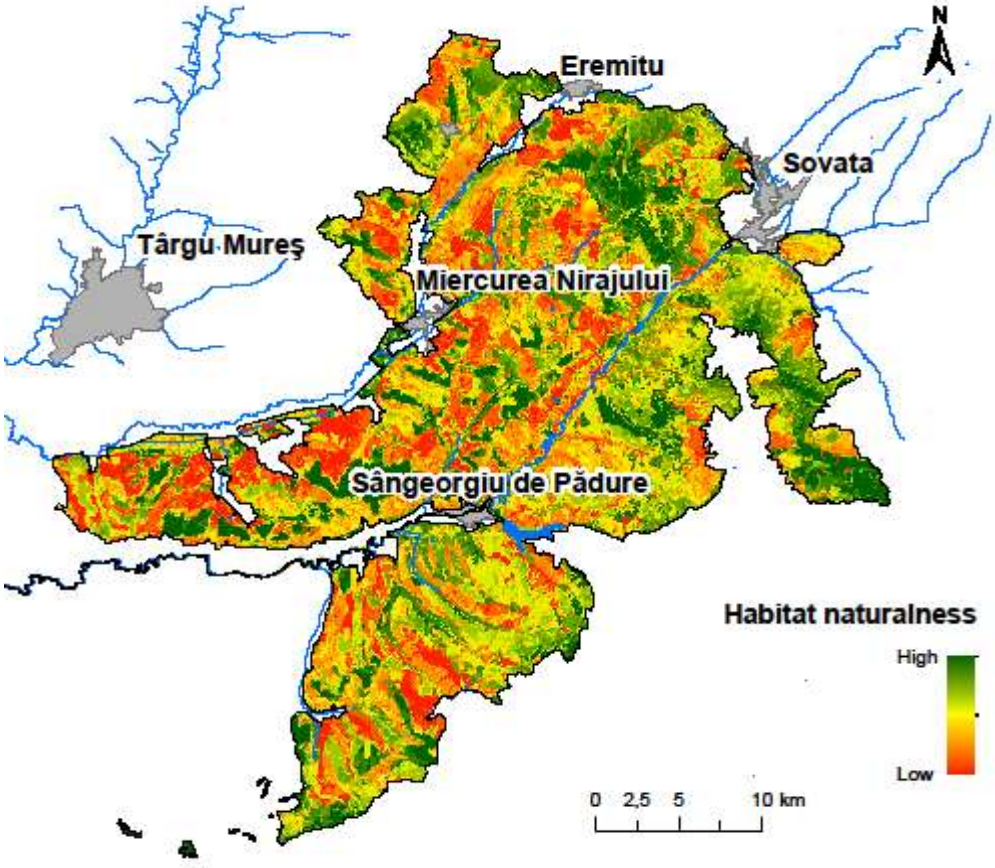


**Fig. 7.11:** Naturalness of habitats: the capacity of habitats to maintain biological diversity estimated using statistical models based on bird distribution data, satellite images and other environmental variables

To estimate the naturalness we fitted penalized maximum likelihood generalized linear models (Friedman et al. 2010) to appropriate environmental predictors and biodiversity data. We chose this relatively modern modelling technique because of its fast convergence and robustness with respect to our correlated predictors, listed in **Table 7.10**. As response variables we used bird occurrence (presence/absence) data from targeted Natura 2000 monitoring activities in 2014. These monitoring activities were adapted to major bird guilds, following the birds' preferences and habitats, and each monitoring activity was named according to a key target species (see **Table 7.11**). Most of these activities followed a common sampling strategy of sampling points at a distance of 400 m along line transects, which were placed with random starting points and directions in the target broad habitat types (open or forested).

**Table 7.10:** Input data layers for naturalness calculation: predictor variables.

| **predictor (proxy) category** | **variables** |
|---|---|
| ecosystem type | the (dominant) habitat type of the grid cell (continuous, see also **Fig. 7.2**) |
| terrain | altitude: average elevation of the SRTM pixels covered by the grid cell (continuous),<br>northing: the north-south component of the normal unit vector of the surface (continuous),<br>easting: the east-west component of the normal unit vector of the surface (continuous, see also Guisan et al. 1999) |
| soil | genetic soil type (factor with 13 categories) |
| water availability, wetness | water distance: Euclidean distance of grid cells from the nearest stream, river or lake |
| human disturbance | road distance: Euclidean distance of grid cells from the nearest road |
| habitat structure | mean reflectance: average values of the Landsat pixels covered by the grid cell (3x continuous)<br>var reflectance: variance of the Landsat pixel values covered by the grid cell (3x continuous) |

**Table 7.11:** Input data layers for naturalness calculation: response variables (training and evaluation datasets). After the number of species recorded we also give the number of species used in modelling (in parentheses). Bird census data collected by Milvus Group, derived from the project Biodiversity and sustainable development in Niraj and Târnava Mică Valley.

| **Surveyname** | **Sampled habitats** | **Key target species** | **No of points** | **No of species** | **Method in brief** |
|---|---|---|---|---|---|
| field_1 | open | *Lullula arborea*<br>*Lanius excubitor*<br>*Perdix perdix*<br>*Upupa epops* | 2252 | 78 (28) | points along line transects, unit sampling effort, April |
| field_2 | open | *Lanius collurio*<br>*Anthus campestris*<br>*Sylvia nisoria*<br>*Lanius minor*<br>*Perdix perdix*<br>*Upupa epops*<br>*Merops apiaster*<br>*Jynx torquilla*<br>*Lanius excubitor* | 3609 | 90 (39) | points along line transects, unit sampling effort, May(-June) |
| forest | forested | *Ficedula albicollis*<br>*Ficedula parva*<br>*Columba oenas* | 1573 | 74 (19) | points along line transects, unit sampling effort, May early morning |
| night | open | *Crex crex*<br>*Asio otus*<br>*Caprimulgus europaeus*<br>*Otus scops* | 826 | 8 (7) | points along line transects, unit sampling effort, May - July at night |
| wood-pecker | forested | *Dendrocopos leucotos*<br>*Dendrocopos medius*<br>*Picus canus*<br>*Dryocopus martius* | 595 | 7 (6) | points along line transects, unit sampling effort, March(-April), early morning, sound playback |
| owl | forested | *Strix uralensis*<br>*Strix aluco* | 565 | 5 (2) | random points along forest roads, unit sampling effort, at night, sound playback, October - November |

We fitted individual *glmnet* models for each survey and species separately with an alpha=0.5 elasticity parameter, and the parsimonious “1SE” rule for setting the lambda parameter, and calculated occurrence probabilities for each grid cell. To aggregate the modelled bird occurrence probabilities

into a naturalness score, we calculated a weighted average of occurrence probabilities, using three sets of weights:

- species conservation value (wt1): between [0, 1], assigned by local experts through an online survey to each bird species;
- model goodness scores (wt2): AUC statistics (Jiménez-Valverde 2012) of the model transformed to the interval [0, 1];
- representativity filter (wt3): a binary (0, 1) weight to filter out the surveys and species that are not representative for the habitat type of the given pixel: i.e. species (and surveys) which are not represented by with at least 20 presences and 20 absences in survey points of the given survey for the specific species.

The overall weights were calculated as the product of the three weights, and the aggregated naturalness score was calculated as the weighted average of the modelled bird species occurrence probabilities. For the purpose of visualization we rescaled the values to an 1-10 ordinal scale using the appropriate quantiles.

### 7.3.9 Landscape diversity

| | |
|---|---|
| Definition: | The habitat diversity of the broader landscape, which contributes to the persistence of several plant and animal species, as well as to an aesthetically appealing environment. |
| Cascade level: | 1 (ecosystem condition) |
| Modelling approach: | statistical model (a Tier 2 landscape index: Shannon diversity of broad habitat types within an 1 km neighbourhood) |
| Input data: | ecosystem map + broad habitat type categories within effective range (viewshed derived size of the moving window) |
| Level of expert involvement: | Individual expert consultations |
| Final map: | colour codes show the ecosystem condition in terms of Shannon diversity values lowest (1) to highest (10) level (**Fig. 7.12**) |

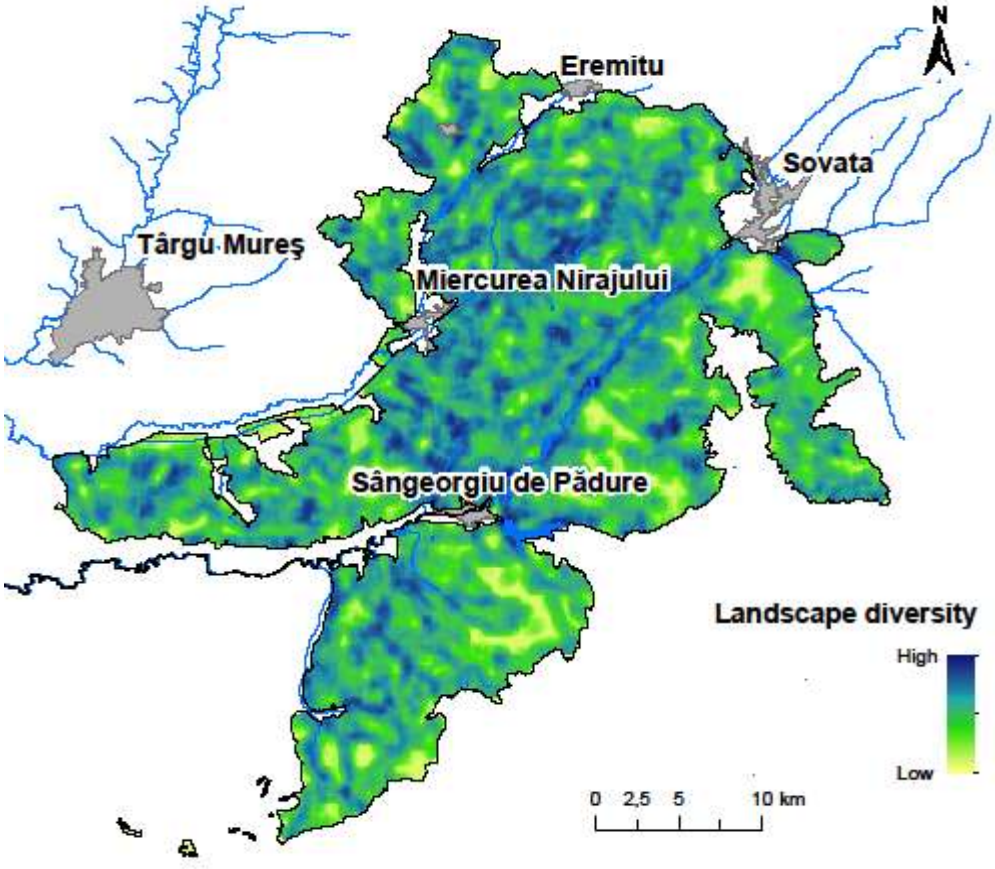


**Fig. 7.12:** Landscape-level habitat diversity expressed with a mathematical formula (Shannon diversity index of the main habitat groups at a rough (~1 km) scale)

In addition to the naturalness of the individual habitat patches that the landscape comprises, the pattern and diversity of these patches constitute a further important factor determining the ecological quality for people and organisms (Williams & Cary 2002, Schippers et al. 2015). Landscape diversity

positively contributes to the survival of many species, and thus the maintenance of biodiversity, as well as the sustainability and resilience of several ecosystem services (Schippers et al. 2015). To quantify landscape diversity we applied a relatively straightforward approach: we calculated the Shannon diversity (Shannon 1948, Pielou 1966) of ecosystem types within a unit neighbourhood for every pixel of the study area (a circular moving window). However, we aggregated our 13 habitat types into eight structural habitat type groups (broad habitat types), so that the resulting diversity values would meaningfully reflect the key structural diversity of ecosystems. The following broad habitat types were identified during expert consultations: settlements, open agricultural (intensive and extensive agricultural areas), open grasslands (hay meadows, pastures), shrublands (encroached grasslands), open forests (wood pastures, orchards, tree groups), evergreen forests (pine and spruce forest), deciduous forests (robinia forests, broad-leaved forests), and waters (water and wetlands).

People perceive the landscape in "viewshed units" (Dramstad et al. 2006) determined by the orography of the study region, which suggested us to use a circle of 1 km radius as a unit area (moving window). As, according to expert consultations, the territories of the most important large bird species are of similar magnitude, and the key factors determining habitat structure (being open or closed, wet or dry, and the degree of disturbance) are the same for humans and birds (or other large bodied vagile animals), we can assume that the landscape diversity index calculated reflects the perception of many species, and is a good choice for representing landscape diversity as an ecosystem condition. All the calculations were performed in the R statistical environment.

### 7.3.10 Soil fertility

| | |
|---|---|
| Definition: | Fertility of the soil is a semi-persistent ecosystem state characteristics affecting the supply of several ES. In case of agro-ecosystems, it determines the ecosystem's potential contribution to the agricultural yield. |
| Cascade level: | 1 (ecosystem condition) |
| Modelling approach: | extended matrix (Tier 2 rule-based model based on the Soil Map of Romania (Harta Solurilor 1978) + slope steepness + elevation |
| Input data: | soil types |
| Level of expert involvement: | individual expert consultations |
| Final map: | colour codes 1-10 show the relative ecosystem condition of the area from lowest (1 - least fertile) to highest (10 - most fertile) level (**Fig. 7.13**) |

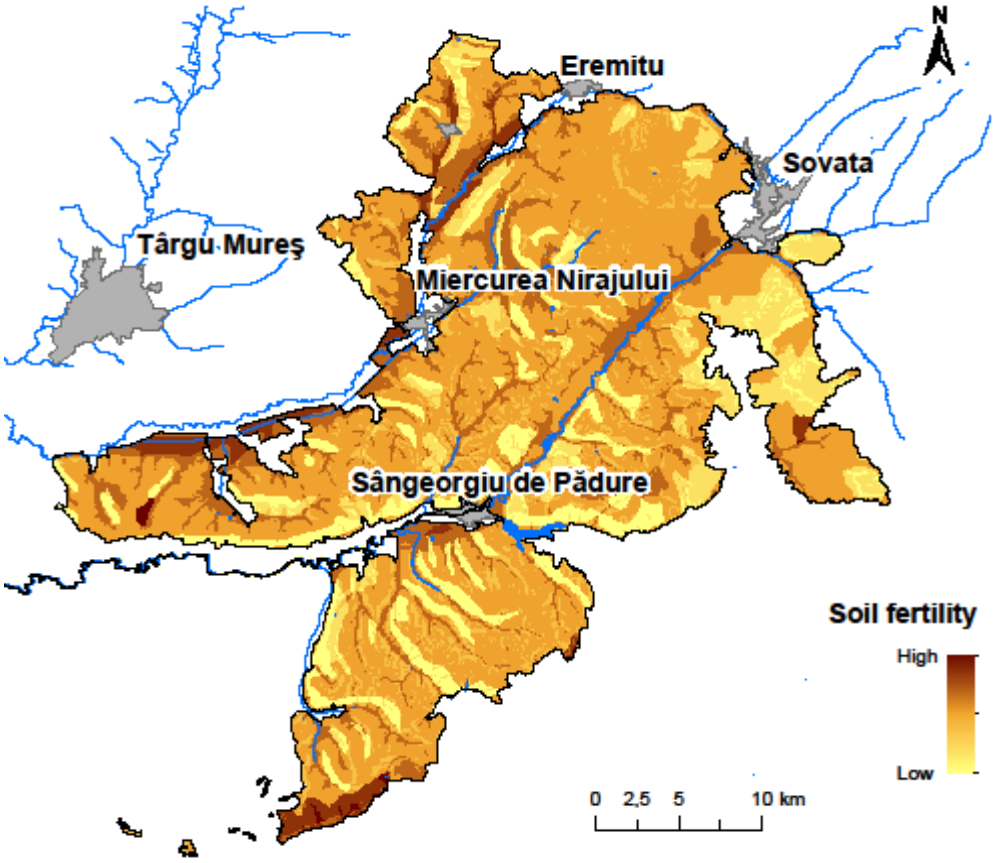


**Fig. 7.13:** Estimated soil fertility (capacity to be used for arable land and stoop crops) on an expert preference scale.

We represented some elements of the list resulting from the assessment of local preferences that were difficult to harmonize with the definition of services indirectly by using appropriate ecosystem condition indicators (*see Chapter 6.2*). One of these is agricultural crops, as, no matter how important

their role may be in the local economy, they cannot be considered as real ecosystem services, due to the high ratio of human input. However, as an ecosystem condition indicator we can take into account soil fertility, which is the most important contribution of ecosystems to agricultural production and crop yields.

Soil fertility was assessed by two experts independently, as an integrating estimate of the soil types' suitability for the most frequently cultivated plants in the area. Soil types were derived from the Soil Map of Romania (Harta Solurilor 1978). Elevation and slope steepness were added to the model in order to account for erosion processes taking place at steeper sites, reducing soil fertility (Elliot et al. 1999, Pimentel et al. 1995, Wischmeier & Smith 1978 ).

**Table 7.12:** Scores for soil fertility (based on expert consultation)

| **Soil type (romanian name)** | **Fertility score** |
|---|---|
| Lăcoviști | 4 |
| Soluri gleice | 6 |
| Soluri pseudogleice | 7 |
| Soluri negre clinohidromorfe | 5 |
| Luvisoluri albice (podzolice argiloiluviale) | 6 |
| Soluri brune argiloiluviale | 5 |
| Soluri brune-luvice (podzolite) | 5 |
| Soluri aluviale | 5 |
| Regosoluri | 1 |
| Soluri brune eu-mezobazice | 3 |
| Soluri cernoziomoide | 8 |
| Erodisoluri | 2 |
| Soluri brune feriiluviale (podzolice) | 6 |
| Podzoluri | 7 |
| Pseudorendzine | 7 |
| Andosoluri | 5 |

### 7.3.11 Aggregated ES maps

The resulting ecosystem service maps express the extent to which certain habitats are able to contribute to securing a specific service. By juxtaposing these maps, the parts of the landscape become comparable, and locations and regions that are particularly important for the provision of specific services can become visible. To facilitate this kind of comparison, we prepared two maps that show, for every single point (pixel) of the study area, the number of services being provided at above average (the upper 50%, **Fig. 7.13**) or outstanding (the top 10%, **Fig. 7.14**) performance.

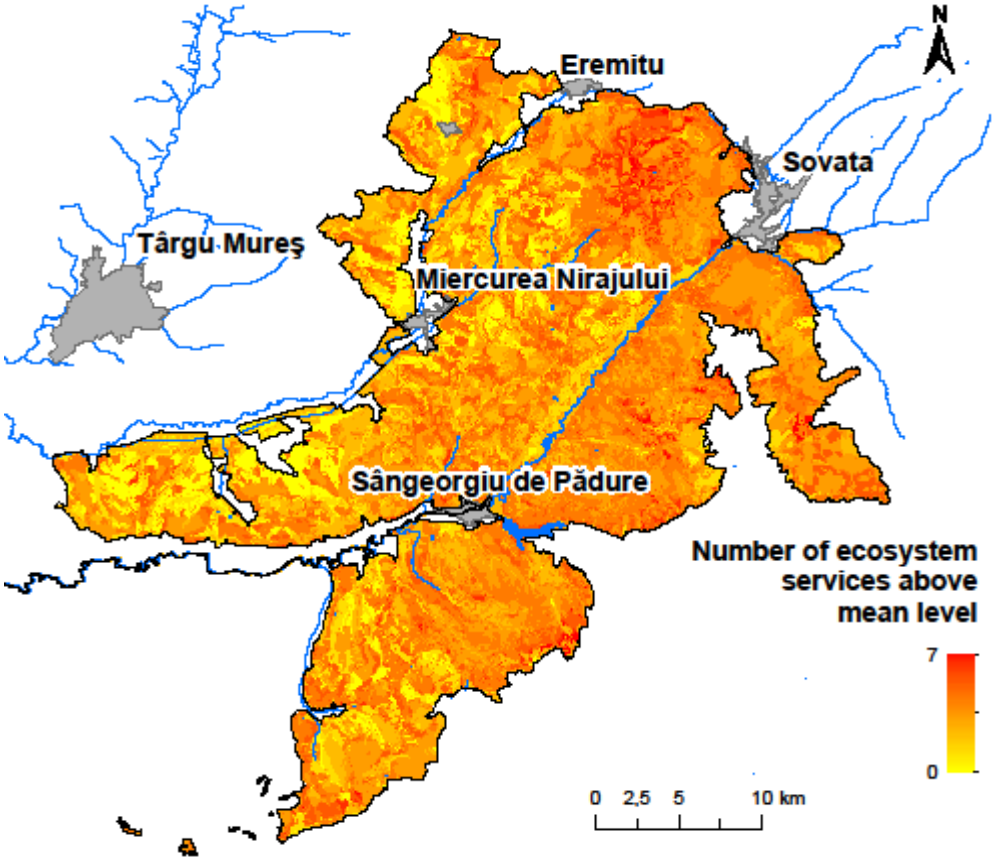


**Fig. 7.14:** Overview of ecosystem services in the Niraj - Târnava Mică region: the number of services provided at an above average level for each pixel

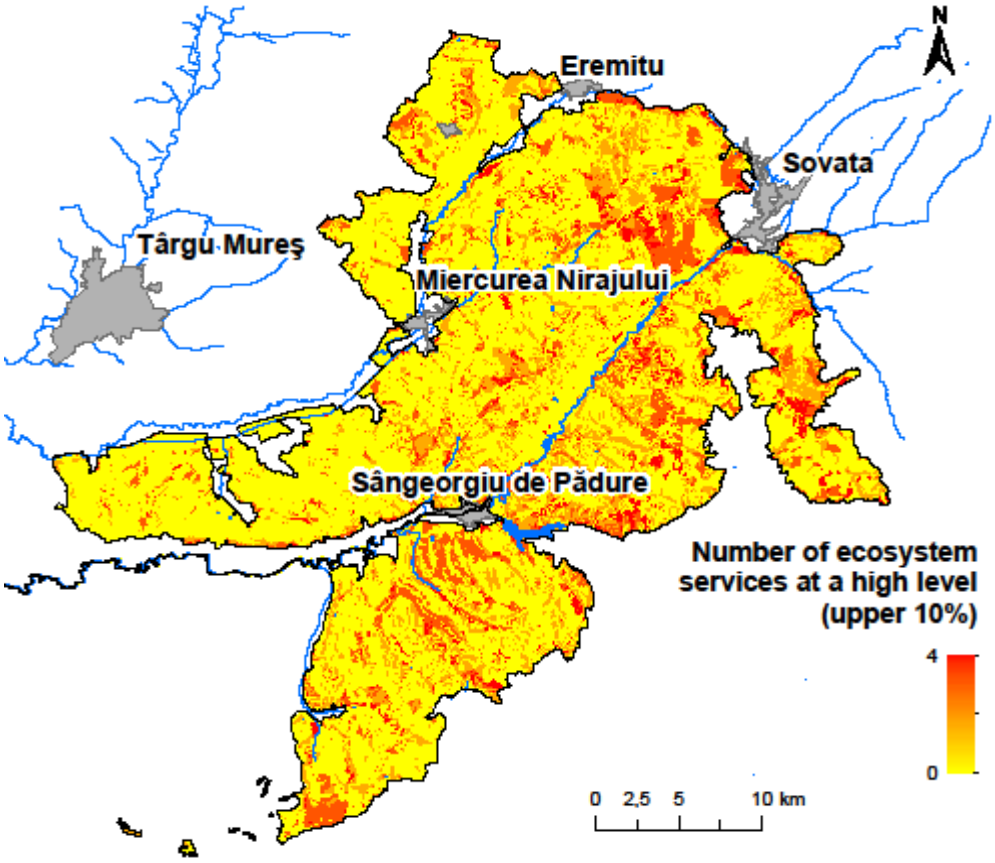


**Fig. 7.15:** Overview of ecosystem services in the Niraj - Târnava Mică region: the number of services provided at an outstanding level for each pixel

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# 8. Valuation of ecosystem services in the Niraj - Târnava Mică region

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Ecosystem services improve people's individual and social well-being in many ways. A healthy environment contributes to preserving the physical and mental health of local people. The local population has an attachment to the land that provides them with roots, identity and common values cohering the community. Well-functioning ecosystems are more resilient to external forces (e.g. climate change) and can better mitigate environmental risks. A significant share of services improves the local economy and livelihoods of locals also directly in the form of market goods and added value.

**Table 8.1:** The three disciplinary domains of ecosystem service valuation.

| | Biophysical valuation | Economic (monetary) valuation | Social (socio-cultural) valuation |
|---|---|---|---|
| Subject of analysis | Quantity of ecosystem services expressed in biological or physical units of measurement | Economic value expressed in monetary terms, economic benefits of the functioning of ecosystems | Benefits provided to different groups of society expressed in monetary or non-monetary terms, identifying the reasons for their values |
| Common questions | How many m3 (cubic meters) of trees can grow in a given area? The production of how many kg of sheepmeat did/would natural vegetation enable? | How much monetary value can forests produce under long-term sustainable management (RON/ha/year)? How much does the monetary value of annual timber harvest volume amount to? | Which ecosystem service is deemed most important in an extensive questionnaire survey, and why? The lack of which services would jeopardize our future, and why? What score do experts assign to the honey-production capacity of different habitat types? |
| Main source of data | Data from literature or measurements, biophysical models | Economic and statistical data, results of the biophysical and social valuation | Opinions and consensus of experts and local stakeholders |
| Advantages | Natural science basis, numerical, standardized (constant, reproducible) methods. More basic model types (matrix models and rule based models) can be well combined with elements of social valuation (expert scoring). | Principal language of the economy and politics. Makes comparison of different services possible, easily comparable to economic indicators of other sectors, good comprehensibility of results. | Applied also for valuation of non-monetary benefits (e.g. spiritual, cultural values). It is able to take into account local knowledge, experience and local specificities. It is also able to identify individual and collective valuation criteria and human factors. |
| Disadvantages/limitations | Valuation/modeling of complex systems is very complicated, lack of data is a common issue, many relevant features of the systems cannot be measured. In most practical cases they are not applicable without integrating social methods. | Societal benefits can be diverse, monetary benefit is only one of them. Available methods involve a large amount of uncertainty. The economic value may be significantly influenced by the current economic and political environment. | Results are strongly influenced by the way experts and stakeholders consulted assess the value of services. The researcher is part of the research, thus in order to obtain the most objective results specific techniques need to be applied. Results always apply to the given context examined (mostly not generalizable), and are difficult to apply in other fields. |

The term "valuation" of ecosystem services describes the combined/summarized evaluation of all aspects (e.g. monetary, social) of usefulness to society. Three main approaches have evolved in the international practice of ecosystem service valuation: biophysical valuation, economic valuation and social (socio-cultural) valuation. The three ways of valuation follow the methods and approaches of the three main scientific fields addressing the topic (natural sciences, economics and social sciences).

The total value of services cannot be expressed in monetary terms in a simple and direct way. Health, security and community cohesion for instance are values that are critical for the future of the local community in an ever-changing world full of challenges, and money is not an appropriate unit of measurement to express their value. In order to obtain a complete overview of the path of ecosystem services from nature to society (see **Fig. 7.1**) and all important societal benefits of these services (e.g. health, security and material well-being), we need to use all three approaches simultaneously ("in an integrated way"). All elements of human well-being should be equally represented in decision making (Kelemen & Pataki 2014). Representing and quantifying these values, however, is by no means an easy task (**Table 8.1**).

In our work we strived to implement the valuation of a wide range of ecosystem services integrating biophysical, social and economic aspects. With this in mind, almost every step of the research process constitutes a form of ecosystem service valuation: ranking of the services in the survey (see *Chapter 6* and 9) can be considered as an extensive social valuation, while the mapping of the majority of services constitutes a biophysical valuation combined with social elements. In this step of our project we complemented these already existing bits of social and biophysical valuation with a layer of economic valuation, in order to achieve a more detailed and more informative picture on the magnitude of value that the functioning of ecosystems provides for this region.
In estimating the economic (monetary) benefits of ecosystems we relied upon two sources: based on the results of the models used for mapping, we were able to give an estimate of the capacity of habitats to provide services (**Fig. 7.1, cascade model**, level 2). For this, expert scores obtained in the previous matrix workshops (see *Chapter 7*) had to be converted first to biophysical units, based on special expert consultations and literature. For the current actual use of services (**Fig. 7.1, cascade model**, level 3), statistical and local data formed the basis of valuation. We used various methods for the monetary valuation of capacities and actual use.

- For most of the **provisioning services** (wood and timber, natural forage and fodder, wild plants and mushrooms, and honey) we used *market prices* as the basis of our calculations. In this case, the concerned ecosystem service should have a market, where it can be sold. In the valuation process we strived to consider least processed products and average prices measured on local markets in the past few years (available to local farmers). We aggregated the monetary benefits of specific habitats for the entire area, thus arriving at a total amount that is provided to the local and national economy by the area as a whole.
- We also used market prices for the valuation of carbon sequestration, based on international emission trading systems. In the case of the other **regulating services** which were directly or indirectly mapped through our ES indicators (water regulation and erosion control through our indicator for water retention, and pollination partly mapped through our indicator for honey) we did not attempt to perform an economic valuation. The data needs and methodological challenges necessary for the valuation of these services were clearly beyond the reach of this project.
- For the valuation of the only **cultural ecosystem service** assessed (touristic attractiveness) we used the *travel cost* method. This method is based on actual consumer behaviour ("revealed preferences"), and value the services based on them. Travel costs address "products" related to getting access to the cultural benefits of natural resources, as a substitute for market price. To value the recreational services of a given area information is needed from a large and representative sample of visitors/tourists. Based on the the

individual preferences a demand curve can be drawn, which can reveal the consumer surplus reflecting the value of the underlying service.

In the next pages we give a detailed description on the materials and methods used during the valuation of ecosystem services and the results obtained for the Niraj - Târnava Mică region.

# 8.1 Wood and timber

## 8.1.1 Calculating provisioning capacity of wood and timber

As we had no access to regional estimations of standing wood volumes, capacities for wood and timber provision were estimated with the help of the rule-based model co-developed with local experts (foresters) (see *Chapter 7*). Furthermore, as most of the data available pertain to the forest areas handled by the Romanian national Forest Land Fund (FLF), we excluded non-FLF forests from the monetary valuation. As in Romania the proportion of non-FLF forests is relatively high (7%), this results in an underestimation of both the capacities and the actual use, especially considering the subsistence use of fuelwood and timber. However, most of the products that are marketed, are based on timber and fuelwood from the FLF areas. It is only 78% of the habitats identified as forests on our habitat map (based on satellite images) that actually belong to the FLF system.

To estimate the total timber provisioning capacities we started out from our habitat map. We determined the typical tree species composition for each of the forested habitat types of the region (**Table 8.2**). Capacities of typically non-FLF habitat types (orchards, forest pastures, encroached grasslands, and rows of trees) were not taken into account in the capacity valuation.

**Table 8.2:** Typical species composition of the most important forest types in the Niraj - Târnava Mică region

| | *Fagus sylvatica* | *Quercus petraea* | *Carpinus betulus* | *Picea abies* | *Pinus* species | *Robinia pseudoacacia* |
|---|---|---|---|---|---|---|
| broad-leaved (<500 m a.s.l.) | 35% | 33% | 22% | | | |
| broad-leaved (500-600 m a.s.l.) | 44% | 29% | 17% | | | |
| broad-leaved (>600 m a.s.l.) | 78% | 5% | 7% | | | |
| pine and spruce forest | | | | 69% | 21% | |
| robinia forest | | | | | | 90% |

Following the structure of the timber capacity model created during the expert workshop, we divided the whole study area into zones according to elevation (low: <500, medium: 500-600, high: >600 m a.s.l.) and slope steepness (flat/steep, below/above the (threshold) value of 17.5° mean slope, calculated over 1 ha). We then calculated the “area” of each major tree species for each elevation and steepness zone combination. To calculate the long term average annual yields for each species and forest type we resorted to the production tables (“Tabele de producţie”, Giurgiu et al. 2004) used for official forestry planning in the Romanian forestry sector. We assigned a production class (“clase de producţie relative”) to each tree species in each zone with the help of local experts, and looked up the

optimal harvest age (i.e. the length of the typical management cycle) as well as the corresponding wood yields from the production tables (**Table 8.3**).

**Table 8.3:** Relative production classes (class) for each major tree species in the different altitude and steepness zones. Optimal harvest age (age), and the amount of average annual production in $m^3ha^{-1}y^{-1}$ was determined using official production tables of the Romanian forestry administration (Giurgiu et al. 2004).

| Species | Class | Age | Production | Zone description |
|---|---|---|---|---|
| *Fagus sylvatica* | II | 120 | 5.8 | above 600 m on flat land |
| | III | 120 | 4.7 | elsewhere |
| | IV | 120 | 3.6 | below 600m on steep slopes |
| *Quercus petraea* | II | 120 | 5.2 | below 500 m on flat land |
| | III | 120 | 4.2 | elsewhere |
| | IV | 120 | 3.1 | above 500 m on steep slopes |
| *Carpinus betulus* | III | 70 | 4.0 | on flat land |
| | IV | 70 | 3.4 | on steep slopes |
| *Picea abies* | II | 70 | 10.9 | on flat land |
| | III | 70 | 9.4 | on steep slopes |
| *Pinus* spp | III | 60 | 5.5 | everywhere |
| *Robinia pseudoacacia* | II | 40 | 10.8 | on flat land |
| | III | 40 | 8.2 | on steep slopes |

### 8.1.2 Actual use of wood and timber

Actual use of timber provision (i.e. cutting) was calculated on the basis of the annual forestry statistics for 2015 (INS 2016). As we had no access to species level data, and we considered the data on secondary production uncertain, we decided to compare actual use to capacities at the level of total primary productions ($m^3$) of the forestry fund area within the Niraj - Târnava Mică region. Based on the share of the study area within the forests of Mureș county (1% in the case of coniferous and 25% for broad-leaved forests) we could estimate the annual cutting volume of the study region for these two broad categories. Shares of harvested beech, oak, hornbeam and robinia within the total cut of broad-leaved forests were then estimated using approximate “average turnover areas” as weights, which were defined as the total area covered by each species divided by the length of the typical management cycle. The raw timber amounts from 2015 cuttings estimated for the study region are shown in **Table 8.4**.

**Table 8.4:** Estimated cutting volumes, prices for standing (unprocessed) wood, and economic values of the 2015 cuttings in the study region.

| Tree species | $m^3$/yr | RON/$m^3$ | RON/yr | EUR/yr |
|---|---|---|---|---|
| Conifers (*Picea, Pinus*) | 3660 | 130 | 475458 | 105657 |
| *Fagus sylvatica* | 37088 | 143 | 5285089 | 1174464 |
| *Quercus petraea* | 15697 | 304 | 4770464 | 1060103 |
| *Carpinus betulus* | 17918 | 184 | 3300542 | 733454 |
| *Robinia pseudoacacia* | 4254 | 198 | 843552 | 187456 |
| Softwood species | 1329 | 121 | 161063 | 35792 |

### 8.1.3 Economic valuation of wood and timber (capacities & actual use)

In order to estimate the economic value of timber provisioning capacities valuation rested on volume prices for unprocessed standing wood from two local private forestry companies. As we could not get prices for all species of interest, we estimated the raw timber prices with a simple linear model using official national processed log (board) prices[5] as predictor, and the local unprocessed prices as calibration data (**Table 8.4**). Thus we calculated that the economic value of annual timber provisioning **capacity** from the FLF areas of the region is 20.1 million RON/year (4.4 million EUR). The economic value of the 2015 timber production from the region, which is the "**actual use**" value of this ES, is estimated to be 14.8 million RON/year (3.3 million EUR), which is ~74% of the total capacities within the forestry fund handled forests of the region.

With an annual capacity value of 20 million RON, forests are not only key ecosystems of the region, but through the provision of timber and firewood, they are key pillars of local economy. Even though the harvest rate of 74% might seem to be favourable to forests, this value still seems to be high if we consider that a 100% harvest rate (cutting all trees over a certain minimum age) would leave virtually no resources for major functional parts of forest biodiversity. Given that no statistical data can be 100% reliable, the real situation can be even worse. Overharvest of forests for timber may endanger the flow of other ecosystem services.

## 8.2 Natural forage and fodder

Natural forage and fodder is one of the most important ESs present in local economy, especially in a historical context. Despite the relatively low score it obtained in the preference assessment (see *Chapter 6*) SAB asked us to retain this ES among the ones chosen for evaluation. However, due to the lack of appropriate data, we only performed an economic valuation of forage and fodder at the actual use level of the cascade. We did not evaluate the capacities for this service, even though the scores that the local experts assigned to the different habitat types of the region were transformed into fodder units (Brüggemann et al. 1959) based on the advice given by the participating experts. Apparently, fodder units could have served as a basis, for transforming capacity scores into benefit volumes (e.g. hay, sheep/mutton, cattle/beef, milk), which could then have been valuated with a market price approach. However, due to the uncertainties of the input maps (habitats and soil), the transformation to fodder units, and the serious ambiguities in the fodder unit approach itself (Wickens 2012), we did not follow this road.

### 8.2.1 Actual use of natural forage and fodder

To give an estimation on the intensity of grassland use, we started out from statistical data on cattle and sheep, as these are the two animals that most extensively rely on natural forage and fodder (hay) during their production cycle. As since 2004 the National Statistical Institute of Romania does not collect and publish animal statistical data at a community level[6], we had to rely on an own survey sent out to 42 communal administrations in the study region in October 2015. We did not only ask the total

[5] Order no.152/2016 of Ministry of the Environment in Romania, on approving the list of reference prices, by species and varieties, set for 2016, to be used in calculating the value of timber, referred in art 22, par.6 of Law no.171/2010
[6] http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=AGR201B

number of animals per species, but the number of ranches ("stână"(ro), "esztena"(hu)), and the number of animals kept on them. As goats are frequently kept together with grazing sheep, and many communities reported an aggregated number for sheep and goats, and these two have similar (and partly complementary) ecological needs and economic outputs, we decided to handle these two species jointly in our analysis. Based on the responses that treated sheep and goats separately, the ratio of goats to sheep is ~1:12. We could also see that on average 82% of the sheep+goats, and 70% of the cattle is kept on the ranches. These numbers were used to perform data amputation (substitution of missing data with estimated values) on the number of ranched animals, wherever only total numbers were available. In the following calculations we assumed that these numbers also estimate the role that natural fodder plays in feeding these animals: and even though grazing animals out in the ranches get occasionally farm-grown fodder, and village held animals also get natural hay, as a reasonable simplification we assumed that these two amounts cancel each other out. The total number of animals on ranches as given by the communes, are given in **Table 8.5**.

As not all of the communes completely fall inside the study area, we also had to include a spatial correction step into our analysis. We estimated the number of animals effectively living within the study region by multiplying the original numbers living on ranches by the fraction of settlement area within the total area of the administrative unit. This way we arrived at an estimated "effective" number of 6176 head of cattle and of 43364 sheep that are feeding on natural forage in the study region.

For assessing the intensity of grazing (**Table 8.6**) we calculated the number of animals per ha, taking all pastures from the habitat map summed up (total of about 24600 ha), neither including wood pastures (minor area of about 1500 ha), nor including encroached grasslands (6974 ha, but rarely grazed).

We transformed the number of sheep and goats to livestock units (LU) by dividing their number by 6.6, adding this to the number of cattle ("Estimated number of ranched animals within the study area (LU))"

We multiplied livestock units with the ratio of each commune that lies within the study area. The results are average grazing intensity values, which are calculated for each commune and cannot be located more accurately. Experts categorised the pastures as "undergrazed" if the value was <0.5 LU per ha and overgrazed if it was > 1.75 LU per ha. These data were also used as input data in the biophysical modelling (*Chapter 7*).

**Table 8.5:** The registered numbers of cattle, sheep, and goats in the communes of the study area in 2015 based on data collected from the communal administrations, and the fraction of communal area lying within the study area. Empty cells show missing data.

| Commune | Fraction of the commune within the study area | Total number of | | Number of ranched | |
|---|---|---|---|---|---|
| | | Cattle | Sheep+goats | Cattle | Sheep+goats |
| Acăţari | 68.9% | 862 | 5104 | | |
| Atid | 48.1% | 1230 | 7601 | 1230 | 7414 |
| Bălăuşeri | 16.0% | 660 | 11470 | 178 | 8636 |
| Beica de Jos | 2.1% | 353 | 4020 | 353 | 4020 |
| Bereni | 100.0% | 325 | 2350 | 313 | 1975 |
| Chibed | 100.0% | 400 | 2360 | 76 | 2356 |
| Chiheru de Jos | 2.2% | | | 138 | 2181 |
| Coroisânmărtin | 3.7% | 145 | 2474 | 62 | 2882 |
| Corund | 11.1% | 1828 | 3013 | 1220 | 1082 |
| Crăciuneşti | 47.5% | 860 | 1352 | | |
| Daneş | 2.3% | 752 | 11635 | 748 | 11138 |
| Dumbrăveni | 0.7% | | | 168 | 1480 |
| Eremitu | 51.8% | 450 | 4360 | 263 | 3942 |
| Ernei | 2.8% | | | 569 | 3000 |
| Fântânele | 85.2% | 500 | 2667 | 430 | 1167 |
| Găleşti | 56.8% | 628 | 4500 | 236 | 3760 |
| Gheorghe Doja | 8.6% | 410 | 2157 | 165 | 1912 |
| Ghindari | 100.0% | 290 | 2350 | 191 | 2300 |
| Gorneşti | 0.4% | 800 | 4300 | 580 | 1284 |
| Hodoşa | 86.1% | 538 | 1753 | 510 | 1300 |
| Hoghilag | 1.4% | 290 | 3045 | 245 | 1935 |
| Lupeni | 2.9% | 1906 | 6200 | 1906 | 5400 |
| Măgherani | 100.0% | 540 | 2350 | 540 | 2080 |
| Miercurea Nirajului | 45.1% | 793 | 5398 | 291 | 2150 |
| Nadeş | 65.2% | 615 | 6750 | 113 | 3433 |
| Neaua | 100.0% | 225 | 2521 | 86 | 1700 |
| Păsăreni | 45.7% | 430 | 3000 | 0 | 2400 |
| Praid | 12.8% | 1490 | 10200 | 980 | 5290 |
| Săcel | 24.4% | | | 179 | 4761 |
| Sângeorgiu de Pădure | 72.8% | | | 220 | 1550 |
| Sărăteni | 99.4% | 397 | 1619 | 397 | 1604 |
| Sighişoara | 10.0% | 107 | 2320 | 65 | 2320 |
| Sovata | 11.0% | 784 | 6300 | 250 | 300 |
| Suplac | 1.6% | 319 | 3946 | 319 | 3329 |
| Vărgata | 77.8% | 280 | 910 | 280 | 910 |
| Veţca | 76.0% | 190 | 3165 | 166 | 3165 |

**Table 8.6:** Corrected numbers of cattle, sheep and goat calculated for the study area, transformed to livestock units (LU), area of pastures according to habitat map of study area and grazing intensity per commune.

| Commune | Fraction of commune within study area | Estimated number ranched within study area | | Total estimated number in LU | Pastures (ha) | Grazing intensity (LU/ha) |
|---|---|---|---|---|---|---|
| | | Cattle | Sheep+goats | | | |
| Acăţari | 68.9% | 416 | 2874 | 851 | 1356 | 0.6 |
| Atid | 48.1% | 596 | 3570 | 1137 | 1226 | 0.9 |
| Bălăuşeri | 16.0% | 74 | 1499 | 301 | 603 | 0.5 |
| Beica de Jos | 2.1% | 7 | 83 | 20 | 28 | 0.7 |
| Bereni | 100.0% | 313 | 1975 | 612 | 923 | 0.7 |
| Chibed | 100.0% | 280 | 2356 | 637 | 1072 | 0.6 |
| Chiheru de Jos | 2.2% | 3 | 48 | 10 | 41 | 0.3 |
| Coroisânmărtin | 3.7% | 4 | 106 | 20 | 13 | 1.5 |
| Corund | 11.1% | 141 | 272 | 183 | 420 | 0.4 |
| Crăciuneşti | 47.5% | 286 | 525 | 365 | 237 | 1.5 |
| Daneş | 2.3% | 17 | 253 | 55 | 1 | 0.6* |
| Dumbrăveni | 0.7% | 1 | 10 | 3 | 0 | |
| Eremitu | 51.8% | 163 | 2041 | 472 | 1221 | 0.4 |
| Ernei | 2.8% | 16 | 83 | 28 | 138 | 0.2 |
| Fântânele | 85.2% | 366 | 1857 | 648 | 2158 | 0.3 |
| Găleşti | 56.8% | 250 | 2137 | 574 | 1197 | 0.5 |
| Gheorghe Doja | 8.6% | 25 | 164 | 50 | 76 | 0.7 |
| Ghindari | 100.0% | 203 | 2300 | 551 | 1770 | 0.3 |
| Gorneşti | 0.4% | 2 | 14 | 5 | 23 | 0.2 |
| Hodoşa | 86.1% | 439 | 1233 | 626 | 821 | 0.8 |
| Hoghilag | 1.4% | 3 | 35 | 9 | 0 | |
| Lupeni | 2.9% | 55 | 157 | 79 | 76 | 1.0 |
| Măgherani | 100.0% | 540 | 2080 | 855 | 800 | 1.1 |
| Miercurea Nirajului | 45.1% | 250 | 1990 | 552 | 552 | 1.0 |
| Nadeş | 65.2% | 281 | 3598 | 826 | 1553 | 0.5 |
| Neaua | 100.0% | 157 | 2061 | 470 | 1357 | 0.3 |
| Păsăreni | 45.7% | 137 | 1120 | 307 | 287 | 1.1 |
| Praid | 12.8% | 134 | 1069 | 296 | 892 | 0.3 |
| Săcel | 24.4% | 44 | 1162 | 220 | 1510 | 0.1 |
| Sângeorgiu de Pădure | 72.8% | 160 | 1128 | 331 | 182 | 1.8 |
| Sărăteni | 99.4% | 395 | 1595 | 636 | 1027 | 0.6 |
| Sighişoara | 10.0% | 7 | 232 | 43 | 328 | 0.1 |
| Sovata | 11.0% | 60 | 566 | 146 | 368 | 0.4 |
| Suplac | 1.6% | 5 | 55 | 13 | 70 | 0.2 |
| Vărgata | 77.8% | 218 | 708 | 325 | 939 | 0.3 |
| Veţca | 76.0% | 126 | 2406 | 491 | 1059 | 0.5 |

*outlier replaced with mean value

### 8.2.2 Economic valuation of natural forage and fodder (actual use)

In order to turn the animal numbers obtained above into biophysical and monetary flows, we assumed a number of conservative simplifications:

- the main benefit from ranch-grown grazing cattle is meat, all the other benefits can be neglected
- half of the registered cattle are cows, the other half are calves, which are kept until an age of 250 days when they are slaughtered
- the weight of an average calf is 300 kg, which can be sold at a price of ~ 2.5 EUR/kg
- the main benefit of sheep is lamb, all other benefits (milk, fleece) are neglectable
- 80% of the registered sheep are ewes, and each ewe produces 0.75 merchantable lambs per year
- an average lamb weighs 20 kg, and can be sold for ~ 11 EUR/kg
- the economic output of goats (~8% of the total number of sheep+goats) equals to that of sheep

Based on all these assumptions we calculated the economic value of the natural forage and fodder of the study region as 7.8 million RON/year (1.7 million EUR) for cattle, and 6.3 million RON/year (1.4 million EUR) for sheep (and goats). All this amounts to an estimated economic value of 14.1 million RON/year (3.1 million EUR) for the actual use of this ecosystem service.

## 8.3 Wild plants and mushrooms

### 8.3.1 Actual use of wild plants and mushrooms

The ES "wild plants and mushrooms" is actually an umbrella term covering many different goods supplied by nature, which share certain characteristics: they are collected from the wild, which needs some expertise, and they are either used for the collectors own consumption or targeted for specialized markets. Essentially all of these goods (species and species parts collected) can be seen as different services, with no trivial "common metric", meaning that 1 kg of one good (e.g. truffles) is not equal to the same amount of the other (e.g. stinging nettles). There was no possibility to convert the scores from the local experts' workshop on the capacity of the different habitat types to supply with these goods to real biophysical quantities. This was due to their variety as well as due to the lack of knowledge on the average amounts of plants/fruits that grow per hectare in the area. Accordingly, we could not estimate the economic value of the (potential) provisioning capacity of the Niraj - Târnava Mică area for this ES.

**Table 8.7:** Mean quantities and corresponding values of plants and mushrooms collected in the Niraj - Târnava Mică region, based on collecting permits.

| | **Plants** | **Funghi** | **Total** |
|---|---|---|---|
| Mean collected quantities [tonnes/yr] | 181 | 35 | 215 |
| Value [million RON/yr] | 1.4 | 0.3 | 1.7 |
| Value [thousand EUR/yr] | 300 | 8 | 308 |

On the other hand we tried to give a tentative estimate on the value of the actual use of this service based on the official collecting permits granted by the Mureș County Environmental Protection Agency (APM Mureș) and the quantities for the different collected species named therein. Permits for the years 2014 and 2015 listed 83 plant and 13 mushroom species altogether (**Table 8.9**). All quantities were averaged per species for the two years with data available. Mean quantities calculated for all collected plants and mushrooms is in **Table 8.7**.

### 8.3.2 Economic valuation of wild plants and mushrooms (actual use)

Prices for the different species and different parts were collected from an online vending platform and some other online resources of regional relevance (www.piata-agricola.ro, http://www.desteptarea.ro). Where available, prices for fresh plant material were used. If there was no information on whether the price in the ad referred to fresh or dry plants, it was mostly assumed that it was for dry plants, giving thereby rather an underestimation of the economic value. If only dry weight prices were available, harvested plant material (as calculated from the permits, see above) was multiplied by 0.2 to reflect weight loss during the drying process (based on the mean value derived from Martin 2010, [7] and [8]). 58 items (species/plant parts) could be valuated this way, which resulted in values for 85% of the quantities harvested. For the remaining 40 items we used average values for fresh/dried plant parts in three categories - *herba*: soft plant parts including leaves, green stems, branches, flowers and buds; *fruit*: generative parts, including capsules, nuts, berries, seeds, etc.; and *root*: belowground or aboveground woody parts, including bark (see **Table 8.8**). The resulting values are in **Table 8.9.** Prices calculated this way were in general noteably higher than those prices mentioned for certain plants in Albu & Mihalcioiu (2014) or averaged to "forest fruits" in the forestry report of the National Institute of Statistics (INS 2016)

Summing up all values, a total benefit of **1.4 million RON/year** (0.3 million EUR) resulting from harvesting and selling berries and herbs can be estimated (**Table 8.7**). Additionally, the mushrooms collected in the region can be valuated with a mean price of 10 RON/kg (a conservative expert estimate based on local market prices), which adds further **0.3 million RON/year** (66 thousand EUR) to this amount.

**Table 8.8:** Mean prices of different plant parts as calculated from offers on online vending platform.

| Plant part | Mean price (RON/kg) | Mean price (EUR/kg) |
|---|---|---|
| Fresh fruit | 9.9 | 2.2 |
| Fresh leaves/flowers | 5.6 | 1.2 |
| Dried leaves/flowers | 13.3 | 2.9 |
| Roots | 20.1 | 4.4 |

[7] http://www.thegoodscentscompany.com/data/ex1090771.html

[8] Tudásbázis - HERBS - Gyógynövényekkel kapcsolatos képzési anyag agrár KKV-k számára - Gyógynövények termesztőüzemi feldolgozása. URL: http://trebag.hu/tudasbazis_cikk/92/gyogynovenyek_termesztouzemi_feldolgozasa last retrieved 30.04.2017

**Table 8.9:** The species and the amount of plant parts collected in the study area, classified into three groups: herba (flowers and leaves), fruit (including nuts, berries, seeds, etc.), root and bark. The price actually used for calculating the total value from the harvested quantities is **bold**, while the used proxies are in *italics* (proxies used where no data available, substituted with mean prices in **Table 8.8**).

| Plant species | plant part | harvested fresh quantity kg/yr in the area | price for fresh plants (RON/kg) | price for dry plants (RON/kg) | total value (RON/year) |
|---|---|---|---|---|---|
| *Achillea millefolium* | herba | 6946 | **4** | 13.5 | 27 785 |
| *Aconitum tauricum* | root | 28 | *20.1* | | 559 |
| *Acorus calamus* | herba | 33 | | **16** | 107 |
| *Aesculus hippocastanum* | fruit | 666 | *9.9* | | 6 610 |
| *Agrimonia eupatoria* | herba | 1602 | | **7** | 2 243 |
| *Alchemilla vulgaris* | herba | 2330 | **4** | 9.5 | 9 322 |
| *Allium ursinum* | herba | 10423 | **6.5** | | 67 750 |
| *Arctium lappa* | root | 755 | *20.1* | | 15 185 |
| | herba | 83 | | **5.5** | 92 |
| *Arnica montana* | herba | 62 | **7** | | 431 |
| *Asarum europaeum* | herba | 571 | *5.6* | | 3 213 |
| *Atropa belladonna* | herba | 44 | *5.6* | | 250 |
| | root | 27 | *20.1* | | 549 |
| *Berberis vulgaris* | root | 95 | *20.1* | | 1 916 |
| *Betula pendula* | herba | 555 | | **7** | 777 |
| *Capsella bursa pastoris* | herba | 28 | **4** | | 111 |
| *Centaurea cyanus* | herba | 1 | *5.6* | | 7 |
| *Centaurium umbellatum* | herba | 95 | | **10** | 189 |
| *Cerasius avium* | fruit | 540 | | **50** | 5 398 |
| *Chelidonium majus* | herba | 440 | | **8** | 703 |
| *Cichorium intybus* | herba | 1248 | | **6** | 1 498 |
| | root | 619 | | **6** | 742 |
| *Colchicum autumnale* | fruit | 179 | *9.9* | | 1 782 |
| *Cornus mas* | fruit | 2203 | **10** | | 22 028 |
| *Coryllus avellana* | fruit | 2436 | **13.5** | | 32 881 |
| | herba | 508 | | **5** | 508 |
| *Crataegus monogyna* | fruit | 7601 | **7.8** | | 59 539 |

| Plant species | plant part | harvested fresh quantity kg/yr in the area | price for fresh plants (RON/kg) | price for dry plants (RON/kg) | total value (RON/year) |
|---|---|---|---|---|---|
| | herba | 1103 | | **7.5** | 1 655 |
| *Dryopteris filix-mas* | root | 619 | **20.1** | | 12 448 |
| *Epilobium parviflorum* | herba | 247 | **5.6** | | 1 391 |
| *Equisetum arvense* | herba | 2719 | **8** | | 21 749 |
| *Eryngium planum* | herba | 583 | *5.6* | | 3 277 |
| *Fagus sylvatica* | fruit | 1126 | *9.9* | | 11 182 |
| *Fragaria vesca* | fruit | 676 | *9.9* | | 6 708 |
| *Filipendula ulmaria* | herba | 111 | *5.6* | | 624 |
| *Frangula alnus* | herba | 76 | *5.6* | | 429 |
| *Fraxinus excelsior* | root | 83 | | **12** | 200 |
| *Galium mollugo* | herba | 285 | | **10** | 570 |
| *Galium verum* | herba | 357 | | **10** | 714 |
| *Geranium robertianum* | herba | 83 | | **10** | 166 |
| *Geum urbanum* | root | 282 | | **20** | 1 129 |
| *Hedera helix* | herba | 571 | | **6** | 686 |
| *Heleborus purpurascens* | root | 76 | *20.1* | | 1 528 |
| *Hieracium pilosella* | herba | 892 | *5.6* | | 5 015 |
| *Hippophae rhamnoides* | fruit | 9972 | **11.5** | 30 | 114 680 |
| | herba | 42 | **5.6** | | 234 |
| *Hypericum perforatum* | herba | 4047 | **6** | 15 | 24 279 |
| *Inula helenium* | root | 55 | *20.1* | | 1 115 |
| *Juglans regia* | fruit | 526 | *9.9* | | 5 221 |
| | herba | 568 | | **15** | 1 703 |
| *Juniperus communis* | fruit | 4099 | | | 40 694 |
| *Lamium album* | herba | 972 | | **7** | 1 361 |
| *Leonurus cardiaca* | herba | 83 | | **6** | 100 |
| *Malus sylvestris* | fruit | 344 | | | 3 411 |
| *Malva sylvestris* | herba | 100 | | **8** | 160 |
| *Melilotus officinalis* | herba | 1358 | | **4** | 1 086 |

| Plant species | plant part | harvested fresh quantity kg/yr in the area | price for fresh plants (RON/kg) | price for dry plants (RON/kg) | total value (RON/year) |
|---|---|---|---|---|---|
| *Mentha aquatica* | herba | 1664 | *5.6* | | 9 363 |
| *Mentha pulegium* | herba | 1110 | | **8** | 1 775 |
| *Origanum vulgare* | herba | 1332 | *5.6* | | 7 490 |
| *Padus avium* | fruit | 1248 | *9.9* | | 12 395 |
| *Petasites hybridus* | root | 4133 | **10** | | 41 334 |
| | herba | 624 | *5.6* | | 3 511 |
| *Pinus sylvestris* | fruit | 1031 | *9.9* | | 10 233 |
| *Plantago lanceolata* | herba | 338 | | **9** | 609 |
| *Polygonum aviculare* | herba | 139 | **5.6** | | 780 |
| *Populus nigra* | herba | 333 | | **17** | 1 132 |
| *Primula officinalis* | herba | 1379 | | **21** | 5 790 |
| *Primula veris* | herba | 1040 | | **21** | 4 369 |
| *Prunus spinosa* | fruit | 7070 | **10** | 40 | 70 699 |
| | herba | 1003 | *5.6* | | 5 640 |
| *Pyrus piraster* | fruit | 277 | *9.9* | | 2 750 |
| *Ribes nigrum* | fruit | 318 | *9.9* | | 3 160 |
| *Robinia pseudacacia* | herba | 1526 | | **11** | 3 356 |
| *Rosa canina* | fruit | 18159 | **12.5** | | 226 983 |
| *Rubus fructicosus* | herba | 1809 | *5.6* | | 10 174 |
| | fruit | 5777 | **10** | | 57 769 |
| *Rubus idaeus* | herba | 1894 | *5.6* | | 10 653 |
| | fruit | 6539 | **16.5** | | 107 887 |
| *Salix alba* | root | 49 | *20.1* | | 992 |
| *Sambucus nigra* | fruit | 14300 | **2** | | 28 601 |
| | herba | 7020 | **5.5** | 12 | 38 611 |
| *Solidago virgaurea* | herba | 1157 | | **27.5** | 6 366 |
| *Sorbus aucuparia* | fruit | 1360 | **30** | | 40 787 |
| *Spiraea ulmifolia* | herba | 832 | *5.6* | | 4 681 |
| *Symphytum officinale* | root | 1677 | **15.5** | | 25 993 |
| *Tanacetum vulgare* | herba | 2267 | | **6** | 2 720 |
| *Taraxacum officinale* | herba | 4651 | | **7.5** | 6 977 |
| | root | 769 | **20** | | 15 390 |

| Plant species | plant part | harvested fresh quantity kg/yr in the area | price for fresh plants (RON/kg) | price for dry plants (RON/kg) | total value (RON/year) |
|---|---|---|---|---|---|
| *Thymus glabrescens* | herba | 511 | *5.6* | | 2 872 |
| *Tilia argentea* | herba | 168 | | **10** | 337 |
| *Tilia cordata* | herba | 2119 | | **6.5** | 2 755 |
| *Tussilago farfara* | herba | 292 | | **15** | 877 |
| *Urtica dioica* | herba | 6343 | **5.5** | 18 | 34 889 |
| *Veratrum album* | root | 381 | *20.1* | | 7 664 |
| *Viburnum opulus* | root | 102 | *20.1* | | 2 053 |
| *Vinca minor* | herba | 380 | *5.6* | | 2 138 |
| *Viola tricolor* | herba | 1871 | *5.6* | | 10 526 |
| *Viscum album* | herba | 1046 | **8** | | 8 368 |

Several sources of uncertainty are included in this estimate, for which reason numbers should be handled with care. Harvested quantities calculated based on permits do not include illegal gathering of wild fruits and mushrooms, which, however is an important subsistence occupation in the region. Indeed, gathering for own consumption for every-day nutrition, as well as selling the raw products (vending on the roadsides or selling bulk quantities to specialized companies) plays a significant role in the livelihood of several social groups, and thus is a relevant part of the local economy.

# 8.4 Honey and nectar

## 8.4.1 Calculating provisioning capacity of honey

Honey providing capacities were estimated with the help of the rule-based model co-developed with local experts, also used for the mapping of this service. According to our conceptual framework of ecosystem services, we considered as 'yields' only the 'net natural yields' of honey, which we define as the yields that can be achieved without external feeding of the colonies. Feeding is a critical human energy input which helps bees' survival during the nectar poor seasons. With this limitation, we assumed however the production of high quality honey, with a relatively high price, which we took into account in the economic valuation. To get a regional valuation of honey provisioning capacities, the ordinal-scale scores assigned to different habitat types by the workshop participants (see *Chapter 7*) were linearly transformed into real biophysical values based on two fitting points (**Table 8.10**). Capacity scores lower than 5 were considered to be insufficient to produce yield or even to sustain bee colonies (starving bees), thus these scores were replaced by 0 (beekeeping is not economical there). We could only perform calibration for a combination of two particularly widespread habitat types (pastures and hay meadows) with the help of a local beekeeper who keeps 40 families all year long in a landscape dominated by these habitat types. For the most productive bee foraging habitats (*Robinia pseudoacacia* forests and *Phacelia* fields) such a calibration was not possible, here we applied data from the literature (Halmágyi & Keresztesi 1991, Nyárádi 1958) after some corrections (**Table 8.10**).

**Table 8.10:** Fitting points for converting nectar provision capacity scores into honey yields

| Score | Yield (kg/ha/yr) | Source |
|---|---|---|
| 5 | 0.41 | Calibration by production data from a local beekeeper |
| 10 | 40 | Based on expert consultations. The theoretical maximum nectar yield of Robinia forests (800-1600 kg/ha/yr, Halmágyi & Keresztesi 1991, Nyárádi 1958), was severely reduced in order to correct for<br>● the relatively unfavourable environmental conditions of the region for Robinia (compared to other regions of Romania)<br>● the big annual variances in Robinia nectar production in the region (the average year is much below an optimal year)<br>● and the amount of honey that the high number of bee colonies that is required in order to be able to harvest the maximum yield during the short flowering period (3-4 colonies/ha) would consume throughout the rest of the year in order to survive (50-100 kg honey/colony) |

To turn all honey capacity scores into production values, we fitted a linear model to the two points (**Table 8.11**).

**Table 8.11:** Yield values assigned to the different expert scores used for calculating honey provisioning capacity

| Score | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Yield (kg/ha/y) | 0 | 0 | 0 | 0 | 0.4 | 8.3 | 16.2 | 24.2 | 32.1 | 40.0 |

Based on all these considerations we found that the annual honey provisioning capacity of the region is **182 tonnes per year**.

### 8.4.2 Actual use of honey

We also estimated the amount of actually produced honey (i.e. actual use level of the ecosystem service of honey provision) based on the number of bee colonies in the communes of the region (2015 data from the same communal survey as natural fodder data), and the estimations of beekeepers (local experts) on the average annual honey provision of local bee colonies.

Since the area of several communes extends beyond the project area, for our calculations we have corrected the number of bee colonies for each commune according to the proportion of Natura 2000 site (which equals our study site) area within the commune area. The so corrected colony numbers were summed up, leading to the total colony number of the study site of 19268 colonies.

There are several communes (e.g. Ghindari, Bereni, Fântânele, Chibed) in the case study region with a high number of local beekeepers who seasonally migrate their hives following abundant nectar sources outside the study area. On the other hand, as the Niraj - Târnava Mică region is not particularly outstanding in terms of nectar provision in Romania, there is almost no migration of beekeepers towards this area from outside. Thus, based on expert consultations we estimated that about half of the locally registered bee colonies produce honey from locally harvested nectar.This assumption was

reflected in our calculations by excluding the migrating colonies, i.e. dividing the total colony number of the study site by two.

Another estimation we made was the average annual honey provision of local bee colonies. This estimation was based on a series of consultations with local beekeepers. Based on that, we calculated with an average annual net yield of honey (assuming self-sustaining colonies with no artificial feeding) of 15 kg per colony, as an average for the whole study area. Thus we did not differentiate between areas of different land use in this sense, but calculated the aggregated net yield of honey production for the whole study area.

Following the above described calculations, the actual honey production (the "actual use" -- cascade level 3 -- of the ES honey provision) is estimated to be 156 tonnes.

### 8.4.3 Economic valuation of honey (capacities and actual use)

To estimate the magnitude of the economic value of honey provision in the region, we multiplied our capacity and actual use estimations with typical local honey prices. We found that there are predominantly two honey types: robinia (*Robinia pseudoacacia*,) and "mixed grassland" type honeys that are produced in the study region, approximately at a 50-50% ratio. Counting with net yields available at low-intensity apicultural techniques (low human input levels) we were conservative at estimating honey quantities, thus we can reasonably assume that it is a relatively good quality product that can be produced in these quantities, and which is predominantly sold at a small scale level. Accordingly, we applied net selling prices available for high quality local products in the region, which is ~ 25 RON/kg (5.50 EUR) for both of these honey types. Actually, this is indeed the market pathway typical to the region, as producers typically do not sell their products to retailers, but locally to tourists and regular local / regional customers.

Based on all these considerations, we can assign an approximate value of **4.5 million RON/year** (1 million EUR) to the calculated honey provision capacity of 182 tonnes per year. The monetary value of the actually produced honey is worth **3.8 million RON** (0.8 million EUR), which is **86%** of the theoretically available maximum level.

This is actually a very high level of actual use, meaning that the honey sector (primarily consisting of many small and flexible enterprises) is very effective in tapping this natural resource available at the price of relatively low initial investment costs for most people. The difference between the theoretical maximum capacity and the estimated actual honey harvest can be accounted to the economic principle of diminishing marginal returns, and probably also by the shortcomings of the official registry of beekeepers (not all bee families are registered). While actual use levels close to (or beyond) capacity levels are detrimental if not even dangerous for some ecosystem services (e.g. timber, natural forage), this is not the case for honey, where overharvesting might only result in less profit for beekeepers, but no negative effects for the environment.

## 8.5 Water retention and soil erosion control

Even though water retention and erosion control were mentioned separately during the interviews, and were introduced as distinct services into the prioritization process, they were later combined, and mapped with the same joint ES indicator. The reason for this decision is that the underlying mechanisms (the deceleration of runoff and increase of infiltration), and thus also the key system

properties that determine the capacity of ecosystems for these two closely related ES are basically the same. Both ESs depend strongly on the land surface cover and its temporal dynamics, which can be well expressed by our ecosystem map (Pimentel et al. 1995, Gajic et al. 2008). Soil erosion due to water can vary to a great degree, depending not just on vegetation cover, but also on the management type (for forest) (Elliot et al. 1999, Zal et al. 2015) or the agricultural practices used (Pimentel et al. 1995).

The best possibility for quantifying the benefit of a regulating service that reduces (=regulates) an environmental risk, is to be equated with the avoided damage (Mburu et al. 2006). Soil erosion can cause various forms of damage, therefore there is also a diversity of options to calculate some aspects of "avoided damage", however it is rather difficult to calculate an all-comprising value for such a complex regulating service as water retention and erosion control. On-site damage consists mainly of reduced nutrient and water availability, while components of off-site damage might be siltation of infrastructure, eutrophication of waters, or undermining foundations (Pimentel et al. 1995).

The quality (roughness, leaf area, permeability, etc.) of the land surface and many other factors influence surface runoff and soil water retention. Most empirical assessments are based on the Universal Soil Loss Equation (USLE) (Wischmeier and Smith 1978), in which rainfall erosivity, soil resistance, slope length, slope gradient, crop/vegetation cover and erosion prevention measures are included, often withadditional factors complemented such as (like, length of vegetation period, or soil compaction (Bastian et al. 2013, Le Bissonnais et al. 2002, Gajic 2008). Most of these data were not available at an appropriate regional level and could therefore not be taken into account. As calculating exact amounts of reduced soil erosion in relation to the actual vegetation cover and the geographic properties of the specific point (pixel) in the study area (which was not feasible), we give an overview of values found in literature.

Bastian et al. (2013) evaluated the on-site damage as a minimum calculation, acknowledging that if off-site effects were included total damage could be much higher. The estimated risk was the annual average soil loss and the thereby decreased soil fertility. Basis for the calculations was the substitute cost approach by Pimentel et al.(1995): the necessary effort to restore the situation before loss (of soil, water storage capacity and fertilizer) using technical methods was estimated, adapted to Saxony (Grünwald, 2011 cited in Bastian et al. 2013). Tall benefits were calculated at 59 EUR per ton avoided soil loss (Grünwald, 2011 cited in Bastian et al. 2013).

Brenner (2010) found that the ES of erosion control of a temperate forest at the Catalan coast amounted to 122 USD/ha/yr, while that of a grassland was 37 USD/ha/yr. In Belgium clean-up costs (off-site damage) due to soil erosion and mud-floods were EUR 54/ha/yr (EC 2013). Taking these numbers as a "rough guide" for some very simple calculations shown in **Table 8.12**, the magnitude of the value of reducing soil erosion could be within 22-26 million RON/yr (4.8-5.7 million EUR/yr) ) for the Niraj - Târnava Mică region.

**Table 8.12:** Literature data for costs of soil erosion control and their adaptation for the Niraj - Târnava Mică area (calculated for 91,000 ha)

| | | | **costs (avoided damage)** | | **costs (avoided damage) for study area** | |
|---|---|---|---|---|---|---|
| **Source** | **country** | **vegetation** | **in EUR/tonnes** | **in EUR/ha/yr** | **in EUR/yr** | **in RON/yr** |

| | | | | | | |
|---|---|---|---|---|---|---|
| Brenner et al. 2010 | Spain | forests | | 112 (122 USD) | 5,194,826[a] | 23,376,717 |
| | | grasslands | | 34 (37 USD) | | |
| EC 2013 | Belgium | - | | 54 | 4,914,000 | 22,113,000 |
| Bastian et al. | Germany | ~⅓ arable land and forest each | 59 | | 5,744,830[b] | 25,851,735 |

a: if weighted by ratio of forests (36%) and grasslands (49%) in the project area
b: calculated with the mean value of annual soil loss of 1.07 tonnes/ha/yr as derived from the ESDAC - PESERA database (Kirkby et al. 2004, S.P.I.04.73. 2004, Panagos et al. 2012) for the project area

# 8.6 Carbon sequestration

## 8.6.1 Calculating capacity for carbon sequestration

The capacities for carbon sequestration were estimated using methodologies suggested by the IPCC as Tier 1 methods (IPCC 2003). We applied this primarily matrix-based modelling approach by assigning the relevant IPCC land cover categories to our habitat types (**Table 8.13**), as shown in the 2013 Romanian National Greenhouse Gas Inventory (Ministry of Environment and Climate Change 2013). With these categories, we followed the calculations described by the Romanian National Greenhouse Gas Inventory, and consulted for more detail the IPCC Guidelines for National Greenhouse Gas Inventories, assigning each habitat category a characteristic carbon-sequestration value. For croplands (orchards, encroached grasslands) these were constant values, whereas for the forests harvest data from Mureş county (for 2015, INS 2016) were the base for the calculations **Table 8.14**.

**Table 8.13:** Habitat types used in the Niraj-MAES project, their corresponding IPCC land cover categories and net $CO_2$ change provided by them.

| **short name** | **IPCC category** | **net $CO_2$ change (gain-loss) (tonnes $ha^{-1}$ $yr^{-1}$)** |
|---|---|---|
| settlement | Settlements: Construction + Roads/Railways | - |
| intensive agricultural | Cropland: Arable | - |
| extensive agricultural | Cropland: Arable | - |
| pasture | Grassland: Pastures + Hayfields; | - |
| hay meadow | Grassland: Pastures + Hayfields; | - |
| encroached grassland | Cropland: revegetated | 14.4 |
| wood pasture | Grassland: Pastures + Hayfields; | - |
| orchard | Cropland: Vineyards + Orchards; | 7.7 |
| tree group | Forestland | - |
| pine and spruce forest | Forestland | 5.8 |
| robinia forest | Forestland | 7.2 |
| broad-leaved forest | Forestland | 6 |
| water | Wetlands: Waters/ponds; | - |

As climate regulation through the reduction of atmospheric carbon dioxide levels is an inherently global ecosystem service, with no further need for human interventions (e.g. harvest efforts, or

processing) in order to be turned into benefits for the society, thus the actual use of carbon sequestration equals the potential supplies (capacities) for this service by definition.

**Table 8.14:** Net $CO_2$ sequestration gains, losses and net change (gain-loss) for the whole Niraj - Târnava Mică region, calculated on the basis of IPCC methodology.

| | | | | **$CO_2$ gain (tonnes year$^{-1}$)** | **$CO_2$ loss (tonnes year$^{-1}$)** | **net $CO_2$ change (tonnes year$^{-1}$)** |
|---|---|---|---|---|---|---|
| CROPLAND | Living biomass | Above ground | woody (vineyards +orchards) | 2 816 | - | 2 816 |
| | | | revegetated (encroached grassland) | 53 242 | - | 53 242 |
| | | Below-ground | | - | - | - |
| | | DOM (deadwood+litter) | | - | - | - |
| | | soil | revegetated (encroached grassland) | 47 129 | | 47 129 |
| | **TOTAL CROPLAND** | | | **103 187** | **-** | **103 187** |
| | | | | | | |
| FORESTS | Living biomass | Above-ground + below-ground | | 282 906 | 139 189 | 143 717 |
| | | DOM (deadwood+litter) | | - | - | - |
| | | soil | | - | - | - |
| | **TOTAL FORESTS** | | | **282 906** | **139 189** | **143 717** |

## 8.6.2 Economic valuation (of capacities and actual use)

Economic valuation of carbon sequestration is based on carbon prices from the major international emission trading system set for carbon within the EU Emission Trading Scheme (ETS, https://ec.europa.eu/clima/policies/ets). Emissions trading is a market-based approach in which participants that reduce their greenhouse gas emissions further than required can trade their excess allowances (the permission to emit one ton of carbon dioxide or carbon dioxide equival) to other participants that have a shortage of allowances (EU ETS Handbook). Therefore, all actions - including the growth of carbon-binding vegetation - that reduces the total amount of carbon produced by the actors can add towards the national GDP.

EU ETS is the world's largest carbon market operating in 31 countries (all 28 EU countries plus Iceland, Liechtenstein and Norway). We used average bid prices from the period 1st Jan - 24th Oct 2016 at the European Energy Exchange (EEX, http://www.eex.com/en/) in Leipzig, which is the common platform for the auctions for the large majority of countries participating in the EU ETS (**Table 8.15**).

**Table 8.15:** Daily transaction statistics from the Emission Spot Primary Market Auction Report of the European Energy Exchange (EEX) for the period 01.01.2016 -- 24.10.2016[9]

| | |
|---|---|
| Maximum bid | 8.2 EUR / $tCO_2$ |
| Minimum bid | 3.45 EUR / $tCO_2$ |
| Difference | 4.75 EUR / $tCO_2$ |
| Average | 5.14 EUR / $tCO_2$ |

Accordingly, we calculated that the ~ 247 000 tonnes of carbon sequestered within the project area, would value 1**.3 million EUR**, which is **5.9 million RON** (exchange rate[10]: EUR 1 = RON 4.5198) in the market.

## 8.7 Touristic attractiveness (economic valuation of actual use)

Touristic attractiveness as an ecosystem service is defined as the contribution of the habitats to human recreation and thus making this region attractive for visitors. The same features also enable the landscape to create emotional bond in local people which is a closely related ecosystem service (local identity), which we did not try to value in economic terms (only with relative scores in expert workshops). To estimate the value of "consumer surplus" expressing the contribution of ecosystems to the regional tourism industry we set up a survey exploring the preferences and expenditures of the visitors coming to the Niraj - Târnava Mică region (travel cost method). We used a sample of tourists at a given point of time (Woolridge 2013)(details see below), and compiled a questionnaire asking details about their travel. In order to reveal in what way the frequency of visits and the costs that occurred during or in relation to the visit are related (the function between the touristic value of the area, the frequency of visits and the travel costs), the questionnaire addressed the following main questions:

- number of days spent in the region,
- purpose of the travel,
- time spent with travelling,
- distance covered by the trip,
- other destinations visited during the same trip,
- concrete costs of travel,
- other, stay related costs,
- number of similar visits per year to this region,
- and the age, educational background, mean monthly income, and number vacation days of the respondent.

The complete questionnaire can be found in the Appendix (*Chapter 12*).

We completed the survey between 12 Aug -- 2 Sep 2016, in nine settlements (Ghinești, Sâmbriaș, Călugăreni, Miercurea Nirajului, Praid, Rigmani, Sângeorgiu de Pădure, Sovata, Câmpul Cetății).

[9] https://www.eex.com/en/market-data/environmental-markets/auction-market/european-emission-allowances-auction/european-emission-allowances-auction-download

[10] European Central Bank Exchange rate, 2016. 11. 17.

Altogether 276 questionnaires were returned. We discarded all records that were incomplete or contained contradictory data. We similarly dropped the records of visits with a primary objective other than tourism or recreation (e.g. business or family visits). However, the primary purpose of most of the visits is tourism and recreation (65% of the visitors).

In order to exclude trips that were mainly outside the relevant area, we evaluated the "pertinence" of the remaining trips in the following way:

- we scored all of the sites/destinations mentioned by the responder as being visited during the same round-trip with 1 if they were within the study area, 0.5 if they were on the border, and 0 otherwise. We took into account the location where the survey took place with adding an additional "1" score to the list.
- we averaged the scores for all the sites within the each trip, and
- we dropped all records with an average "pertinence score" below 0.5.

After this thorough screening there were altogether 138 records that met all the criteria. For these records we calculated the costs of each journey, according to the following cost categories:

- concrete costs of travel (e.g. bus or train or plane ticket, gasoline),
- other, stay related costs (e.g. accommodation, meals, entrance fees), and
- opportunity costs for the time spent with the travel (this time could have been spent with other activities)

The first two cost categories could be directly calculated from the responses using appropriate currency conversions, whereas the cost of travel time was estimated as the time spent by travel multiplied by 30% of the average hourly revenue of the responder. The most common types of other costs were food, accommodation, entry fees, and souvenirs followed by excursions, guides, massage, and local transportation costs. All of the three cost types were multiplied by the "pertinence score" of the trip, thus proportionally downweighting the costs for trips that contained also out-of-region destinations (**Table 8.16**).

**Table 8.16:** Statistical overview of the travel costs of tourists visiting the Niraj - Târnava Mică area

| | all trips (n=138) | | | | one-day trips (n=34) | | | | overnight trips (n=104) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Min. | Med. | Mean | Max. | Min. | Med. | Mean | Max. | Min. | Med. | Mean | Max. |
| concrete costs of travel | 0.0 | 17.4 | 37.1 | 500.0 | 2.8 | 9.2 | 16.3 | 100.0 | 0.0 | 20.0 | 43.9 | 500.0 |
| other, stay related costs | 0.2 | 2.45 | 4.54 | 64 | 0.15 | 1.2 | 1.6 | 6.8 | 0.2 | 2.788 | 5.5 | 64 |
| opportunity costs for travel time | 0.0 | 11.3 | 31.4 | 449.5 | 0.0 | 2.6 | 6.3 | 22.5 | 0.0 | 16.9 | 39.6 | 449.5 |

In addition to the estimation of costs, there were several further interesting lessons to be learned from the outcomes of the questionnaire. The distance the visitors in the sample had to travel to reach their destination ranged between 10 and 2200 km, with a median of 96 km. The average visitor spent 1.5 hours to reach the study region. Most of the visitors come from nearby, and this is especially true for one-day visits. Half of the visitors are ethnic Hungarians living in Romania. Most of the visitors (23%) come to the area for excursions, hiking. Visiting festivals or cultural events, photographing, visiting churches and buying local products were reasons named somewhat less frequently (13%, 11%, 10-10%, respectively). Some tourists also shared some ideas on what to improve in terms of touristic facilities. The most common suggestions include enhancing opportunities to visit churches and get to

know local customs, traditions (crafts, agricultural practices, local food and housing) and folk art (stated by 8-10-12%, respectively).

To analyze the relationship between the frequency (demand) and the costs of the visits we followed the analysis pathway of Wieland and Horowitz (2007). We split the remaining records into two categories: one-day trips (34) and overnight trips (104), as these constitute fundamentally different "products" that cannot be estimated by a single undifferentiated model in a conceptually sound way. We then fitted simplified log-normal models for both datasets, using the total cost, age group, education level, and the number of vacation days as predictor variables and logarithm of visit frequency (number of visits per year) as the response variable. The significance of the predictors were tested in a stepwise forward framework. The models with the significant predictors characterise the demand curve for these trips, and the consumer surplus per trip (characterising the average value of a recreational trip to the study area) can be estimated by -1/(the coefficient of *total cost*).

**Table 8.17:** Significance of the terms in the log-normal model for overnight trips (p.value).

| term | df | sumsq | rss | AIC | p.value |
|---|---|---|---|---|---|
| (Intercept) | | | 192.4 | 66.0 | |
| Total cost of travel | 1 | 11.5 | 180.9 | 61.6 | 0.01* |
| Number of holidays per year | 4 | 1.9 | 190.5 | 73.0 | 0.91 |
| Education | 2 | 2.3 | 190.1 | 68.7 | 0.53 |
| Age group | 4 | 21.2 | 171.3 | 61.9 | 0.02* |

Having done this analysis we found that in the case of overnight visits there were two significant terms (*total cost* and *age group*, **Table 8.17**), whereas for one-day visits *total cost* was the only significant predictor. Accordingly, we calculated the surplus of a journey from slightly different models in the two cases. The consumer surplus of a one-day trip was found to be 44 EUR/trip, whereas an average overnight trip is worth 530 EUR.

To estimate the total value of this ES we needed to get an estimate on the total number of one-day and overnight trips targeting the Niraj Târnava Mică area. We started out from official statistical data on the number of visitor nights in the communes of Harghita and Mureș counties between 2011-2015 (INS, TEMPO-online database[11]). We could find data for 21 (out of 42) settlements of the study area, which included all cities and many rural communes. For these communes we estimated the spatially corrected number of visitor nights by multiplying average yearly visitor night numbers by the fraction of settlement area within the total area of the administrative unit. To estimate an approximate number of visitor nights for the rest of the study area (all small villages) we calculated an average "visitor night rate" (1.98 visitor nights / $km^2$ / year) based on numbers from seven administrative units consisting exclusively of small villages (all from which we had data excluding Acățari, which is essentially a suburb of Târgu Mureș). After these corrections we found that the estimated annual number of visitor nights in the Niraj- Târnava Mică region was 23499 nights/year in the period 2011-2015.

Based on the results of our survey, we could see that the average duration of overnight trips was 3.4 days in our sample. If we assume that there is no great seasonal variation in trip duration then this means that the 23499 visitor nights equal approximately 6871 overnight trips altogether. Unfortunately, the number of one-day trips is not available from statistical data, but we could use the

[11] http://statistici.insse.ro/shop/index.jsp?page=tempo3&lang=en&ind=TUR105E

ratio between the two types of trips in our sample (~1 one-day trip per 3 overnight trips) to give a very rough estimate on the annual number of day-trips (2244 trips/year). This gives an estimated consumer surplus of 16.4 million RON/year (3.6 million EUR ) for overnight trips, and 0.4 million RON/year (87 thousand EUR) for one-day trips. This amounts to a total of 16.9 million RON/year (3.7 million EUR) as the estimated economic value of the contribution of natural ecosystems to the tourism industry of the Niraj - Târnava Mică region.

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# 9. The relationship between local business and ecosystem services in the Niraj - Târnava Mică region

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Depending on its sphere of activity, every single business is dependent on different ecosystem services while at the same time impacts on a certain set of ecosystem services. It is in every business's long-term interest to have a clear view of the relationship between its economic activity and natural capital. Negative or positive changes in the state of ecosystems carry with them a multitude of risks and opportunities. The risks include increasing resource shortage, rising prices, lower productivity, or damages/losses due to operations not conforming to new environmental policies. However, sustainable use of ecosystem services may also open up new opportunities for businesses, which can manifest themselves in productivity increase, a more successful utilization of national or EU-level support systems, increase in better social acceptance or, for that matter, in shaping regional or national policies.

## 9.1 Methods to assess the relationship between economic actors and ES

Based on the results of preliminary research and literature review we found that the Corporate Ecosystem Services Review (ESR) (Hanson et al. 2012), designed to review and examine corporate ecosystem services, was the most expedient method for developing and implementing a questionnaire on economic involvement. ESR is a tool designed for corporate leaders to facilitate the development of a corporate strategy based on the analysis of a business's dependence on natural capital (ecosystem services) and its impact on these. The method that goes beyond traditional environmental impact assessments provides a simple, easy-to-handle analysis framework for businesses to properly treat challenges and opportunities related to ecosystem services. Although primarily designed for large corporations, ESR can be effectively used to map spheres of operation of small and middle-sized enterprises that are critical for resource utilisation and in terms of environmental impact. Results of the dependency impact matrix help identify both the challenges and opportunities presented by changes in natural capital relevant for the company's long-term operation by summarising the knowledge accumulated in the field of existing and expected environmental threats and changes in the regulatory environment. In the literature review we examined several similar evaluation methods but they did not prove to be suitable for the local economic environment due to their complexity, their field of application or different target groups. The Global Reporting Initiative (GRI 2011) also studies the relationship between economic activity and natural capital using indicators developed for dependency, environmental impact, and potential/expected advantages and environmental threats. However, since its primary purpose is to facilitate sustainability reporting and because its implementation is rather costly and resource intensive, it is not a suitable tool for preparing a survey in the local economic environment. The Ecosystem Services Benchmark (ESB) (Grigg et al. 2009) was designed to help investors assess the reporting processes of a given business's risk management and

ecosystem services. A secondary target audience of the method is made up of large corporations dealing with trade of foodstuffs, beverages and tobacco products, which makes the method unsuitable for examining the economic involvement of companies with production primarily for internal markets and self-sufficiency.

We needed a simple and comprehensive tool to examine and evaluate the small and medium-sized companies of the region which deal mainly with small scale agriculture. In the end we used a modified version of the dependency impact matrix of ESR in our questionnaire survey. We replaced the question on environmental impact with a supplementary question on dependency since the companies in the examined economic environment that were interviewed do not have the relevant data and, of course, have no interest in presenting their activity in a negative light. As a result, we would not have received realistic answers that could have been used in further analyses.

## 9.2 The questionnaire on economic involvement

Using the questionnaire in the appendix, in two steps we examined economic involvement, i.e., the extent to which the economic actors interviewed depend on particular ecosystem services. First we examined the natural capital dependency of the business using a 0-to-5 scale. Our questionnaire was based on the list of the ten ecosystem services (seven ecosystem services and three ecosystem conditions) previously identified (see *Chapter 6.1*), from which 12 keywords were derived for the questionnaires (**Table 9.1**). Some services we referred to with two different headings in the questionnaires as the close connection between the two (same underlying functions/motivations) were not expected to be obvious to everyone.

We determined dependency as a function of the extent to which the business utilises natural capital and the extent to which economic activity is dependent on the services listed. Then we wanted to see how the success of different businesses would change if the already given ecosystem services were to completely disappear. We measured the answers on a -5-to +5 scale, where -5 marked a considerably worsening, +5 a significant improvement of the business's success, while  marked the present situation. Finally we asked what the most important (external or internal) rules were that they had to observe in relation to the listed natural capital. This question was necessary so that we could explore how businesses perceive direct regulatory environment regarding natural capital-related economic involvement and whether they had any internal regulation to preserve values.

**Table 9.1:** List of ES selected for assessment, their names used in the questionnaires and their definitions.

| name of ecosystem service | name(s) in questionnaire | definition |
|---|---|---|
| **habitat naturalness** | diversity of nature (biodiversity) | The naturalness (incl. biodiversity and resilience) of the habitat. This ecosystem state influences the provision of several ecosystem services within and beyond the ones studied in this project, e.g. pest control, disease control, pollination. |
| **soil fertility** | soil fertility | Fertility of the soil is a semi-persistent ecosystem state affecting the supply of several ES. In the case of agro-ecosystems, it determines the ecosystem's potential contribution to the agricultural yield. |
| **wood and timber** | timber | Long-term timber and firewood provisioning potential of the habitat, assessed as a yearly average considering the whole lifecycle of the habitat, not taking effects of climate change into account. |
| **natural forage and fodder** | hay, grazing | Potential forage supply provided by the ecosystems through mowing or grazing. Cultivated or marketed roughage and grain feed are not included while grazing on fallow land and stubble as well as grasses spontaneously occurring on waysides and banks are included in this service. |
| **wild plants and mushrooms** | medicinal herbs, mushrooms and berries | Gathered mushrooms, fruits, berries and medicinal herbs provided spontaneously by the habitat. Cultivated plants and mushrooms are not included. |
| **honey** | honey and nectar | Potential of the habitat to supply nectar and pollen for honeybees and so contribute to honey production. |
| | pollinating | |
| **water retention** | sufficient water (quantity and quality) | Contribution of the land cover to slowing down the passage of surface water and thus to the recharge of regional groundwater resources and the mitigation of soil erosion. |
| | mitigation of soil erosion | |
| **carbon sequestration** | mitigation of climate change | Sequestration and storage of atmospheric carbon by the habitat, as contribution to global climate change mitigation. |
| **touristic attractiveness** | touristic attractiveness | Contribution of the habitat to the touristic attraction value of the area. Habitats allow recreation and create emotional bond in local people. |
| | local identity | |

## 9.3 Results

### 9.3.1 Characteristics of businesses responding to the questionnaire

We interviewed the leaders/representatives of a total of 55 businesses during our survey in September 2016. The registered offices of the businesses involved in the survey are in the following 14 settlements: Păsăreni, Bolintineni, Vărgata, Valea, Mărculeni, Călugăreni, Măgherani, Eremitu, Șilea Nirajului, Eremieni, Mitrești, Bereni, Torba, and Câmpu Cetății. Fifty percent of the businesses asked were concentrated in Păsăreni, Măgherani and Eremitu with nine businesses in each settlement. We were able to examine the economic involvement of six businesses in Bereni, four businesses in Vărgata, Valea and Mitrești each, and one to three businesses scattered in the other seven settlements. When choosing the businesses we wanted our survey to cover a wide variety of economic activities so that we could find out about the economic involvement of these businesses in as many different economic sectors and spheres of activity as possible. The 55 businesses that we approached represented numerous business activities. To categorise them, we used the preliminary list of sectors of the questionnaire given in the appendix. The basis for the categorisation was the Romanian system for classification of economic activities (Clasificarea Activităților din Economia Națională, CAEN[12]), which we simplified to suit the most common business types of the region. In order to further analyse data, we grouped the businesses into eight larger categories. 90% of these businesses are micro businesses with a further four small and five medium-sized ones (see **Fig. 9.1**).

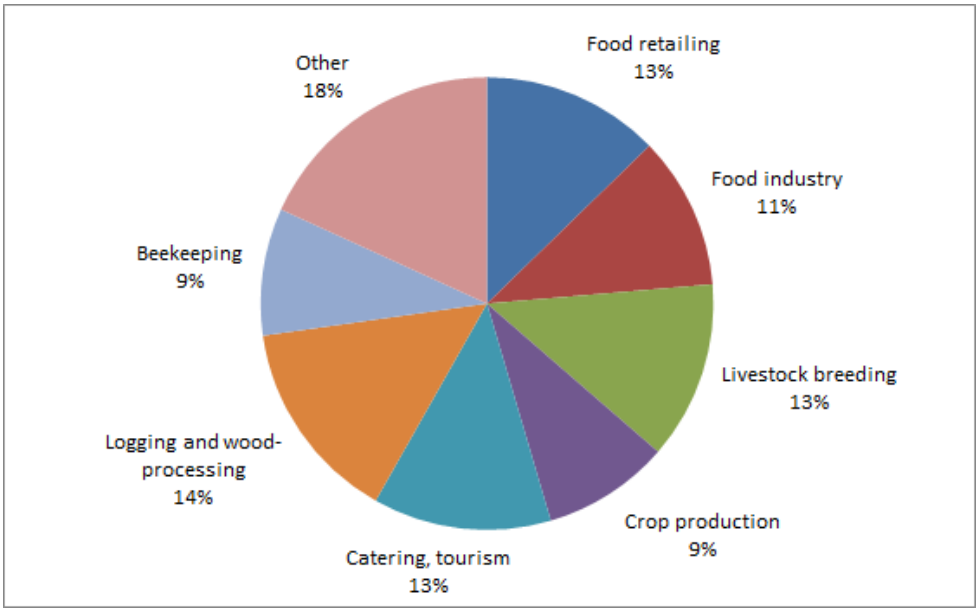


**Fig. 9.1:** Distribution of businesses by economic sector

[12] http://www.coduri-caen.com/

## 9.3.2 The most important ESs for local businesses

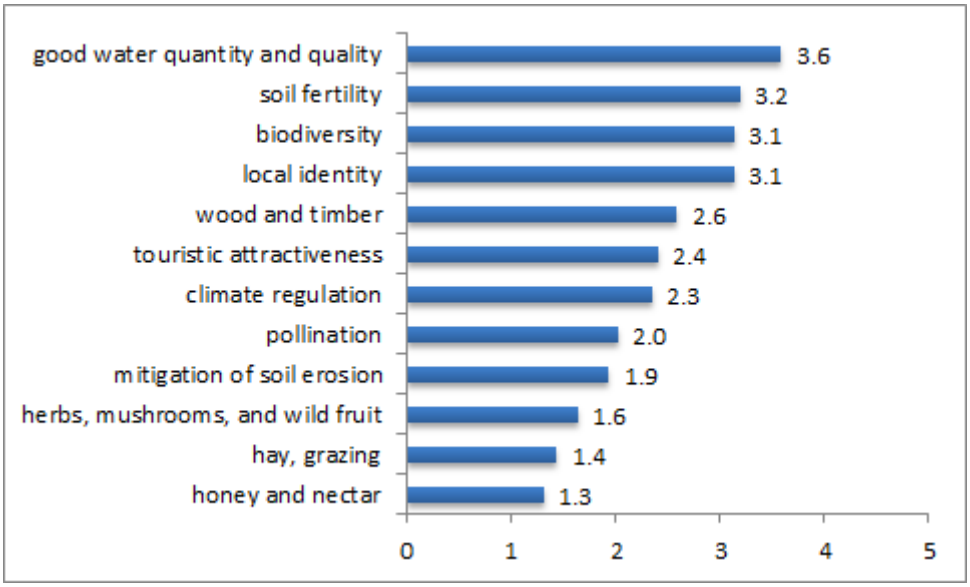


**Fig. 9.2:** Importance of ecosystem services from a business perspective.

Of the 12 identified ecosystem services the businesses, like the general population (see *Chapter 6.1*), found good water quantity and quality the most important from the point of view of their operation (see **Fig. 9.2**). Water was given a mean value of 3.6 on the 0-to-5 scale and, with the exception of 16 businesses (out of 55 - first of all in the logging and wood processing industry, pharmacies, catering units and groceries), was given the highest scores (4's and 5's). This was followed by soil fertility with a mean score of 3.2. Soil fertility was given the lowest values (0's and 1's) by businesses which were only indirectly dependent on this service, mainly in the food and retail industry and catering. Third on the list of evaluated ecosystem services was biodiversity with a mean of 3.1 on a 0-to-5 scale. The service was given all 4's and 5's by businesses involved in livestock breeding and crop production, beekeepers, and those involved in the logging and wood processing industry. It was the least important for businesses involved in the food industry and retailing as well as catering. Local identity came in third on the businesses' list of priorities with a mean of 3.1.

## 9.3.3 Evaluating ESs by the different sectors

**Table 9.2:** Evaluation of ecosystem services by sector. Colour codes emphasize score values.

| | Livestock breeding (n=7) | Bee-keeping (n=5) | Crop production (n=5) | Logging and wood-processing (n=8) | Food retailing (n=7) | Food industry (n=6) | Catering, tourism (n=7) | Other (n=10) | Mean (n=55) |
|---|---|---|---|---|---|---|---|---|---|
| **Biodiversity** | 4.7 | 5 | 4.8 | 4.2 | 1.5 | 2.1 | 2.1 | 2.1 | **3.1** |
| **Soil fertility** | 5 | 4.4 | 4.8 | 3.7 | 1.5 | 3.1 | 1.5 | 2.7 | **3.2** |
| **Hay, grazing** | 4.8 | 1.2 | 2.8 | 0.3 | 0.7 | 1.3 | 0.4 | 1.1 | **1.4** |
| **Timber** | 2.7 | 2 | 2.8 | 5 | 1.7 | 1.1 | 2.2 | 2.5 | **2.6** |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Medicinal herbs, mushrooms, wild fruit** | 2 | 2.8 | 2 | 0.8 | 1.5 | 0.6 | 1.8 | 1.8 | **1.6** |
| **Honey, nectar** | 1 | 5 | 1.4 | 0.3 | 1.1 | 0.3 | 1.4 | 1 | **1.3** |
| **Pollination** | 2.7 | 5 | 2.6 | 1.1 | 1.5 | 2 | 1.5 | 1.4 | **2** |
| **Good water quantity and quality** | 4.8 | 4.4 | 5 | 3.3 | 2.8 | 3 | 3.2 | 3 | **3.6** |
| **Mitigation of erosion** | 2.7 | 1.6 | 2 | 1.8 | 1.5 | 1.1 | 1.5 | 2.7 | **1.9** |
| **Climate regulation** | 2.8 | 4.4 | 3.6 | 1.8 | 2 | 1.8 | 1.2 | 2 | **2.3** |
| **Touristic attractiveness** | 1.1 | 2.8 | 3 | 1 | 4.2 | 1 | 4.1 | 2 | **2.4** |
| **Local identity** | 3.2 | 3.2 | 3.4 | 1.8 | 4.1 | 2.1 | 3.8 | 3 | **3.1** |

In order to visually present the results of our survey we also used colour codes to better highlight the increasing importance of ecosystem services for businesses (**Table 9.2**). The table shows that water, soil fertility and biodiversity received the highest scores (between 4 and 5). Good water quality and quantity is among the key services in most sectors except for beekeeping while evaluation of the other services (ES) shows a rather varied picture across sectors. In the food retail industry the most important services were touristic attractiveness and local identity at values of 4.2 and 4.1, respectively, followed by water at 2.8. Businesses in the food industry awarded the highest score to soil fertility (3.1) and water (3). In the catering industry, like in retailing, touristic attractiveness (4.1) and local identity (3.8) play the most important roles with water following in third place (3.2). Businesses in livestock breeding were unanimous in giving the highest score, 5, to soil fertility but they also awarded high scores to water, hay, and biodiversity. For crop producers the decisive factors were water (5), diversity of nature (4.8), and soil fertility (4.8). All respondents are fully dependent (5) on wood and timber as an indispensable service in logging and wood processing but diversity of nature (4.2) is also an important factor. Businesses in beekeeping awarded three services with 5's, being completely dependent on honey-nectar, pollination, and biodiversity. They also awarded soil fertility, water, and climate regulation with a mean of 4.4, finding them extremely important. The "other" category comprising businesses in the construction and service industries showed great variation. This is easily explained by the heterogeneity of the businesses belonging to the category and by the fact that three of the ten businesses (two pharmacies and a hairdresser) awarded all services with 0.

**Table 9.3:** To what extent do services impact businesses' success? Colour codes emphasize score values.

| | Livestock breeding (n=7) | Bee-keeping (n=5) | Crop production (n=5) | Logging and wood-processing (n=8) | Food retailing (n=7) | Food industry (n=6) | Catering, tourism (n=7) | Other (n=10) | Mean (n=55) |
|---|---|---|---|---|---|---|---|---|---|
| **Biodiversity** | -4.5 | -5 | -5 | -3.6 | -2.2 | -3.1 | -2.1 | -2.5 | -3.3 |
| **Soil fertility** | -5 | -5 | -4.8 | -4.1 | -1.7 | -4 | -1.4 | -2.9 | -3.4 |
| **Hay, grazing** | -4.8 | -1.4 | -2.6 | -0.2 | -0.8 | -2.1 | -0.5 | -1.1 | -1.5 |
| **Timber** | -3.1 | -2.2 | -3 | -4.8 | -1.7 | -1.8 | -2 | -2.6 | -2.6 |
| **Medicinal herbs, mushrooms, wild fruit** | -2 | -2.8 | -2.4 | -0.7 | -1.2 | -1 | -1.4 | -1.4 | -1.5 |
| **Honey, nectar** | -1 | -5 | -1.4 | -0.1 | -1 | -0.5 | -0.5 | -0.7 | -1 |
| **Pollination** | -2.2 | -5 | -3.6 | -1.3 | -1.4 | -2 | -1.8 | -1.4 | -2 |
| **Good water quantity and quality** | -4.8 | -5 | -4.8 | -4 | -2.8 | -3.6 | -2.5 | -3.2 | -3.7 |
| **Mitigation of erosion** | -2.7 | -2 | -1.8 | -3 | -1.1 | -1.8 | -1.5 | -2.5 | -2.1 |
| **Climate regulation** | -3.4 | -4.2 | -3.8 | -2 | -1.8 | -2.3 | -1 | -1.7 | -2.3 |
| **Touristic attractiveness** | -1.1 | -2.4 | -3.4 | -0.8 | -4.7 | -1.1 | -4.1 | -2.3 | -2.5 |
| **Local identity** | -3.4 | -4 | -2 | -2.3 | -4.1 | -2.1 | -3.7 | -2.9 | -3.1 |

**Table 9.3** shows an almost identical picture to the results of **Table 9.2**, which can lead us to conclude that the respondents also replied consistently to the question "How do you think the success of your businesses would change if the following ecosystem services were to completely disappear?" The food retail industry deemed the loss of touristic attractiveness (-4.7) and local identity (-4.1) and any negative changes in these services most important. In contrast, businesses in the food industry thought that the most important factor was soil fertility, awarding it a -4 value followed by good water quantity and quality (-3.6) and biodiversity (-3.1). Results in the tourism category look similar to the ones in food retailing: touristic attractiveness (-4.1) and local identity (-3.7) were the two most important factors. Businesses in livestock breeding all regard soil fertility as the most decisive factor for the success of their business, invariably awarding a value of -5 ("would cause considerable impairment") to it. Damage to or "loss" of soil fertility was followed by that of water, hay (both at -4.8) and biodiversity (-4.5) as factors that would cause the most problems for businesses. According to businesses in crop production "loss" of biodiversity would represent the greatest (-5) hardship in future, followed by loss of soil fertility and water (both at -4.8). The long-term operation of businesses in logging and wood processing would be most adversely impacted by loss of timber (-4.8), soil fertility (-4.1) and worsening of water quantity and quality (-4). Those in beekeeping unanimously think that the success of their business would considerably suffer if the following five ecosystem services were

to completely disappear: honey, nectar; pollination; good water quantity and quality; biodiversity, and soil fertility. Like in table **Table 9.2**, in cases of businesses belonging to the "other" category we found no services whose "loss" would be evaluated as an unambiguous negative effect.

### 9.3.4 Categorisation of important regulations

The survey on economic involvement also addressed the issue of the most important external or internal regulations for the respondents to observe in connection with ecosystem services. The following regulations were listed:

- management, treatment and recycling of waste,
- use of chemicals,
- land use regulations, (keeping appropriate distances in agriculture and beekeeping, sufficient space for animals),
- agricultural regulation (crop rotation, grazing, use of manure, and storage),
- use of water (irrigation, quality and quantity of water supply),
- forestry regulation (sustainable and responsible forestry (FSC) certification, forestry schedules),
- Nature conservation (Natura 2000),
- fire control, and
- quality certification.

None of the respondents made any reference to concrete legislation or specific regulations, only key issues of regulation were mentioned. In addition to the key issues of regulation the respondents highlighted soil erosion mitigation, preservation of soil quality and local identity, the importance of diversity of landscape, responsible tourist behavior, and preservation of natural capital, which were not related to one single concrete issue of regulation. Close to 30% of respondents did not answer the questions.

Businesses involved in individual sectors highlighted the regulations pertaining to their own sector. Those working in livestock breeding and crop production found the regulations pertaining to waste management and use of chemicals, use of manure, grazing and water management as well land use regulations (e.g. crop rotation, proper distance of manure from water supplies and inhabited areas, and the size of space per animal) most important. For people employed in the logging and wood processing industries the most relevant factors were sawdust management, fire control, waste management, forestry laws (logging implementing forest management plan), nature conservation (Natura 2000), protection of water supplies and soil. Those working in beekeeping found the regulations pertaining to use of chemicals and land use (place and rules of installation of beehives) most important. Few concrete rules featured in the responses of the catering and tourism sectors other than quality assurance. However, the responses suggested that they assumed a positive relationship between well-being, (responsible) tourism, and assets of the landscape ("the more diverse the landscape, the more tourists it attracts"). One third of businesses involved in the foodstuff industry and the food processing industry responded to the questionnaire, stressing proper livestock breeding (meat and meat products) and soil fertility in their answers. The answers given by businesses in the "other" sector feature protection of soil fertility, local identity and water supplies. While both large and small businesses were able to name precise regulations, most of the non-responders were small business owners. A logging factory with 50 and a wooden spoon factory with 80 employees were both

able to name precise regulations (e.g. in relation to sawdust treatment) as were businesses employing 5 people. Nevertheless, most non-responders came from businesses with a maximum of 5 employees. Registered office of the business had no impact on the answers to the questions. In response to the supplementary question (Which question/s/ did you find difficult to answer?) four respondents signaled difficulty (they were not familiar with important regulations, or, due to the negative connotation associated with the word regulation, gave no answer, fearing punishment).

Typically, respondents highlighted external regulations only. Only one respondent said that "they were trying to achieve mitigation of soil erosion", meaning they would take steps to mitigate erosion of their own accord, without external regulation.

## 9.4 Conclusions from the Corporate Ecosystem Services Review

In accordance with the results obtained by the survey performed among the population, respondents of the questionnaire on economic involvement also regarded water (good quantity and quality) as the most important ecosystem service. Combined analysis of the two questions on dependency showed that every sector categorized water as one of the key natural assets. This also shows that, irrespective of sphere of activity, water and proper water management are indispensable for businesses. It also suggests that most businesses have already directly experienced shortage of this ecosystem. With the other 11 ecosystem services, prioritising was mostly economic activity-specific, so, for instance, timber was given high scores in the logging and wood processing industries while hay was awarded high mean values in grazing and livestock breeding. Ecosystem services in the lower half of the diagram (**Fig. 9.2** ) showing aggregate order of priorities, including honey-nectar, hay-grazing, pollination or wild fruit were given lower values because, according to respondents, these are direct prerequisites for the successful operation of certain sectors only. Respondents, 90% of whom are micro-enterprises, evaluated ecosystem services mainly depending on which of them directly impact the operation and survival of the business. Pollination, e.g., only received a mean of 1.76 on a 0-to-5 scale and it was not listed among the key ecosystem services by any sector, except for beekeeping. Naturally, this does not mean that this service is not important for businesses, especially for ones in the food industry and crop production. Instead, it shows that the regulating and supporting services which indirectly influence the success of a business remain in the background compared to the provisioning services. We cannot use this information to draw far-reaching consequences because we had not asked our respondents to give reasons for their answers. However, it can serve as an indicator in terms of local businesses' view and approach on natural capital and ES.

We can also conclude that local identity and touristic attractiveness are particularly important for sectors where the service provider is in direct contact with the consumer (food retailing and catering). This holds true for livestock breeding and crop production as well, while the presence of tourists is not particularly important for farmers who intend their products primarily for self-sufficiency or for local markets, their operation is not significantly affected by changes in tourism. The role of touristic attractiveness may significantly increase in the future when services of agro- and gentle tourism have developed.

### Limitations of the method

Although using a questionnaire has allowed us to gain more in-depth knowledge of how local businesses relate to the listed ecosystem services and along what kind of regulation they carry out their economic activity, our research has some limitations, too. The survey conducted of 55 local businesses cannot be considered a representative sample but, as it was a supplementary study, we did not expect it to be representative, either. It was important, however, to reach a distribution according to balanced spatial and economic activity, a task we successfully performed by covering 14 different settlements and about 20 spheres of activity.

As the modified ESR method did not assess the effects of businesses on ecological services, we could not compare dependency on natural capital with the effects exerted on it. On the other hand, having mapped, in preliminary surveys, certain ecological services and their capacities that are greatly impacted, we can use the existing knowledge in interpreting the results of the questionnaire.

The question on services impacting the success of the business was difficult to interpret as testified by several respondents' feedback. The wording of the question "complete disappearance of natural assets" made it considerably more difficult to answer it, which might have affected the results. As only four out of 55 respondents provided this feedback, it does not threaten the overall validity of the results. This is also supported by the fact that comparison of the answers to the two questions reveals that they almost completely confirm each other. This way the second question allows for some kind of cross-check, too.

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# 10. Future Scenarios in the Niraj - Târnava Mică region

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Previous results of the presented research revealed that the landscape provides a multitude of ecosystem services to the local population of the Niraj - Târnava Mică region. Nature has long been securing these services for local people, and there are still many whose livelihood directly depends on these services. The goal of the scenario planning process is to explore the future scenarios envisioned by people living in the Niraj - Târnava Mică region, and to examine how the capacity of habitats to provide ecosystem services is reflected in these scenarios.

Ecosystems that provide their essential services are complicated natural systems. We affect their operation with every decision, be it cutting down a tree, building a new road or pension, or stopping grazing on a hill. However, making the right decisions is not an easy task: often private interest flies in the face of public interest, short term runs counter to long term. Furthermore, we do not understand the interrelatedness of the complex systems either, hence we have difficulty seeing clearly the possible consequences of our decisions. Moreover, our future is threatened by countless uncertain economic, social or environmental factors from climate change to geopolitical processes which make decision-making or even giving advice on concrete issues all the more difficult.

However, there is an option in the arsenal of science for tackling such deeply uncertain and complex issues: scenario planning. The main aim of scenario planning is to condense all the unknown and uncertain factors into a few different but internally consistent scenarios by considering the main driving forces and covering the main uncertainties of the future. Scenarios focus on the common, joint effect of different factors. They create the impression as if we were studying how the different colours and shapes move on a large tapestry if one thread or the other is pulled.

Scenario planning is not a scientific process in the strict sense of the word: without the extensive participation of and dialogue between those involved, there is no chance of understanding interrelatedness or identifying values and threats. Accordingly, during scenario planning and evaluation we intended to address and involve all major social and professional layers of the local community. Without the participation of the experts of sectors including agriculture, forestry, water management, tourism, education, and others, the results achieved can easily show internal contradictions and can poorly reflect natural relationships as well as local and social idiosyncrasies.

The scenarios were developed as a sequence of several distinctive steps. In the following, we give a brief description of each step, the four scenarios developed with local stakeholders and the evaluation of these scenarios. At the end of the study, we summarize recommendations that the Advisory Board (AB), comprising locals, formulated for the institutional systems connected to land use.

## 10.1 The scenario planning process

The scenario planning process featured four main steps:

1. **Determining the drivers**: By drivers we mean all the influences and driving forces that determine the direction of the present and expected development of the local society and have an effect on the condition of the natural environment too. Drivers are **highly influential** factors that are **uncertain** at the same time, and thus encompass a considerable degree of all uncertainties in the future development of the studied system (van't Klooster & van Asselt 2006). The major drivers in the Niraj - Târnava Mică region were determined with the help of the Advisory Board. Members of the Advisory Board selected the two drivers that they deemed most important of all the collected ones:
    a. the *cohesive force of the community* with
        *i.* *strong, close-knit communities* versus
        *ii.* *weak, diverging communities*
    b. the *attitude towards environment in land use regulation* with
        *i.* *environmentally friendly regulation* versus
        *ii.* *non-environmentally friendly regulation*

    as the two possible 'endpoints' (extremes) of the respective drivers representing the range of uncertainties. We identified two further major drivers, that will critically influence the future, but which seem to be less uncertain than the two key drivers selected:
    c. an increased global warming, and
    d. the dynamic development of technology.
2. **Developing alternative storylines**: The selected drivers only create a 'skeleton' or 'scaffold' which needs to be 'fleshed out' with narratives (storylines) in order to get plausible alternative scenarios (van't Klooster & van Asselt 2006). Therefore, we engaged local stakeholders in a workshop, in order to build these storylines. Four alternative scenarios were created, along the selected drivers.→ *see details in Chapter 10.2*
3. **Evaluating the scenarios**: The evaluation of the scenarios consisted of two steps:
    a. As a first step of the scenario evaluation we ***'quantified' the scenarios*** in terms of ecosystem services: we estimated how the studied ecosystem services will plausibly change in the different scenarios relying on the ES models we had previously developed (see *Chapter 7*). → *see details in Chapter 10.3.1*
    b. This was followed by a ***deliberative valuation*** workshop examining the effect of the above on the well-being of the local population. The evaluation was followed by the selection of the scenario that would be ideal for the local people. → *see details in Chapter 10.3.2*
4. **Developing recommendations**: Results of the scenario evaluation workshop and the chosen scenario were presented to the Advisory Board and we asked them to come up with recommendations for the major sectors affecting land use so that the chosen scenario could become reality by 2040. → *see details in Chapter 10.4*

## 10.2 The selection of the drivers and the construction of the storylines

As a first step of the process we examined, relying on the help of the Advisory Board, what were the critical economic, social, land use and regulatory drivers that have the greatest impact on ecosystems and hence on the availability of their services. After identifying these drivers and selecting the two most important of them with the participation of the local experts and stakeholders, we determined the two endpoints of the two key drivers (**Fig. 10.1**).

With these four drivers identified, adding the two fix drivers that can be reliably predicted (climate change; technological development) we developed four scenarios. The best way to get really realistic and plausible storylines that reflect the idiosyncrasies of the local social and ecological systems is to engage a broad range of regional stakeholders during the scenario development process. We accomplished this during a full-day scenario building workshop with the participation of 22 stakeholders. Four alternative scenarios were created by four focus groups of four or five local people answering thematic questions. Participants had to try to imagine how these drivers will influence people's lives and nature by the year 2040 . In other words, they had to envision, what the future might hold for us given the various assemblages of the different factors.

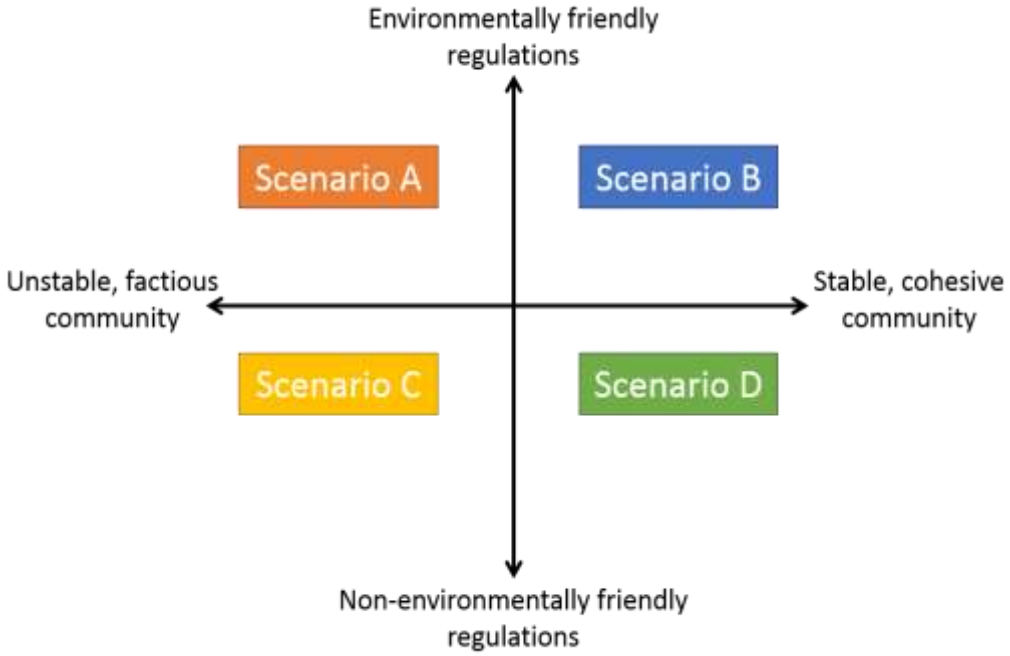


**Fig. 10.1:** End-points of the two key drivers determining the future development of the region.

In order to guide the participants in and to help them to develop the storylines, the following questions were presented to them:

- How will the livelihood of people living here change in 2040?
- What kind of land use types will dominate the landscape?
- How will the people adapt to the challenges of climate change?
- What kind of technologies will people use?
- How will tourism change?

Based on their own draft-scenarios and especially on the thoughts on land use changes, they next continued to explore in a guided discussion, what the resulting landscape might look like. At the end of the group work participants visualized their scenarios and created a photo montage.

In the following section we present the four jointly constructed scenarios.

### 10.2.1 Scenario "A": As helpful as kissing frogs

The scenario titled "As helpful as kissing frogs" was created based on the endpoints of the **unstable**, **divided community** and the **environmentally-friendly regulation** axes. Participants had difficulty envisioning an effective regulatory environment in a divided community, thus the latter appeared much stronger and was more significant within the scenario.

In this scenario, the average standard of living of the population is low and there are significant social disparities within the community. Changes in the local population are largely determined by the distance from urban settlements (cities) and the natural conditions. The population is declining on a regional level but it shows variation among settlements of the region. Peri-urban settlements are becoming more and more urbanized and only their population is increasing, but the new, wealthy inhabitants do not form communities. These settlements are characterized by diverse cultural and ethnic composition. The population of more remote villages is significantly declining, and their ethnic composition is changing. Medium and large-scale farmers are present in small number in the region, but the majority of today's population emigrate, are ageing or die. A small share of villages with an attractive landscape transform into holiday villages, preserving the traditional village landscape. Many owners of the houses are of Romanian nationality. Villages with less favourable characteristics are lagging behind. The majority of population in these settlements are Roma. They become poorer and their health deteriorates as they do not have access to healthcare services in cities due to a lack of money.

Green regulation incentivizes conscious water use, however, the community does not have dissuasive effects and there is no money or willingness in lagging settlements to pay attention to environmental protection. Thus, water contamination incidents are common, and water quantity is not sufficient and not accessible for all social groups. Health problems might also arise due to contaminated drinking water.

The region's agrarian character is preserved, and industrialization is not common except for a few small and medium enterprises involved in business activities such as wood processing or tourism. There will be large differences in terms of the livelihood of the population depending on settlement type and size of land. Inhabitants of peri-urban settlements commute, as they cannot find the means of livelihood in the local landscape. In remote rural villages, those who are able to support themselves are predominantly involved in medium and large-scale farming. Landowners who maintain small-scale farms still typical for the region at present suffer deprivation, ageing and unemployment and live on social benefits.

The majority of land is concentrated in the hands of a few people or companies. The largest ones manage lands of more than 100 ha. They gained access to it by acquiring land owned by ageing smallholder farmers. Among them are also investors, foreigners who do not reside in the area. The environmentally friendly regulation incentivizes extensive farming, thus facilitating the establishment

of medium and large extensive organic farms (they receive subsidies for the transition to organic farming) that dominate the market, while the smaller ones have no access to opportunities. The larger farms direct production towards global markets and sell their produce to large collectors. Medium-sized (a few dozen ha) farm owners are resident families who started to modernize earlier (before 2040) or recently, and have access to subsidies, thus are able to sustain their operations. Land concentration to some extent is also common among them, and they produce for external markets, too. The majority of small-scale farms (4-5 ha) have disappeared, or the owners have emigrated, or sold their land. Those few who stayed in the region are not able to continue self-sufficient farming and fall into poverty. The mosaic nature of the landscape is declining as a result of changes in the ownership structure, but large homogenous areas common to plains are not formed due to the specific terrain of the area.

New animal (e.g. ostrich) and plant species appear that are more resilient to a warmer, drier climate, as the majority of indigenous species are not able to adapt to climate change or are not suitable for large-scale farming. Despite the difficulties, there are a growing number of animals. Beef cattle and sheep grazing are predominant in the region. Intensive stable breeding is also common, while backyard breeding has disappeared.

Problems arise with the quantity and quality of water, too. Water is owned by the state, and national level regulation supports valley-scale environmentally friendly water retention investments. Nevertheless, the problem of water shortage in a small area cannot be resolved individually. Many thus try to secure water with even deeper wells (70+), which further exacerbates the situation. Only the largest farms can afford to introduce integrated water retention practices and exploit economies of scale. Examples for such practices in the case of subsidies developed to incentivize them include afforestation, small dams, and creating wetlands.

Modern, state-of-the-art technology is present in large and medium sized farms if financial resources are available. Only the largest farms are able to make a transition to modern technology; medium sized farms only have access to one piece of equipment each.

Nature and the landscape continue to offer touristic potential, but community-level tourism development is hindered by the lack of community cohesion. The region does not become a real touristic destination that can offer programmes that last several days; touristic services e.g. agrotourism and fishing tourism remain only on a family or individual level. Only some villages with favourable characteristics are able to capitalize on their tourism potential. Transit tourism building on passengers passing through the area and visitors of larger nearby destinations is also common in the region. The community does not benefit from the generated income. Hungarian tourists, previously accounting for 60% (2016) of the total number of tourists, used to visit the region for the live community and traditions, but this attractiveness has now (2040) disappeared. A great proportion of tourists will comprise of former residents who return for their holidays.

Despite environmentally friendly regulation, the mosaic nature, diversity and naturalness of the landscape as well as biodiversity decrease due to problems induced by global warming and changes in land ownership (the dissolution of current small-scale farming). Nevertheless, there is no room for a completely homogenous landscape to be formed due to geographical and terrain conditions.

The majority of land is cultivated, only the least fertile areas are abandoned. This leaves little room for natural processes. Demand for biomass and firewood increases due to higher energy prices, putting

forests under increased pressure. Environmentally friendly regulation encourages the planting of native trees.

As pastures are under increased pressure due to the increased number of livestock, abandoned pastures are also recultivated.

Invasive species have not spread in the region as green regulation adopts measures to prevent it.

The traditional village and settlement landscape as well as the traditional built environment disappears as a result of changes in the ethnic composition of the population. Common assets and public spaces are neglected due to the lack of a cohesive community that would look after them, resulting in reduced touristic attractiveness. A variety of buildings (e.g. halls, warehouses, stables) appear in areas of intensive farming that are not appropriate for the landscape. Residential parks and housing estates are established on the periphery of peri-urban zones. There is increased fragmentation due to the road network.

Significant environmental protection regulations are in place thanks to the green regulatory system, and environmental awareness is higher. However, pollution incidents are still common due to the lack of community cohesion.

The proportion of grasslands, ploughlands and forest habitats can be found in almost equal proportions: forests and grasslands cover approximately the same amount of area, while ploughlands account for 10% more of the total area. The built environment expands in the areas covered by ploughlands and grasslands; residential parks appear in the vicinity of larger cities, industrial buildings and halls in other places. On remaining ploughlands large-scale, intensively cultivated parcels replace small-scale mosaic farming. In parts of ploughlands new energy plantations appear (Paulownia, energy willow).

Grasslands are overgrazed; abandoned, encroached grasslands are recultivated, too. The practice of undersowing grasslands becomes widespread. However, in some places scrubs (e.g. raspberry, elderberry) and new energy plantations appear on grasslands.

There is a slight increase in forest area due to the previous (2016) forest management strategy (it sets out a 10% increase in forest area). The regulation lays down the plantation of native species. Demand for firewood increases, more specifically for fast growing, climate change resilient tree species. Afforestation occurs primarily in degraded areas. Today's forest and black pine plantations dry out.

The region's capacity to provide wood and timber as an ecosystem service slightly increases due to an increase in the share of forests/plantations. The capacity of specific forest types to provide wood and timber declines (e.g. black pine), but this is offset by new plantations of wooded industrial plants grown for energy use. However, actual use and demand for firewood also increase.

The region's capacity to provide edible wild plants remains unchanged. While the ecological status of habitats deteriorates and species and landscape diversity declines due to overused grasslands and recultivated abandoned areas, forest cover expands and the borders of forests provide many edible wild plants.

Black locust plantations retreat due to the green regulations in place, thus reducing the production of acacia honey. The honey production capacity of other habitats also declines significantly due to declining biodiversity, recultivated abandoned lands, overgrazed grasslands and the homogenization of small-scale ploughlands.

Land managers strive to maximize the capacity of ploughlands for grass fodder quantity by e.g. undersowing. Grazing is reintroduced on previously abandoned ploughlands. The quality of ploughlands deteriorates as a result of a deteriorating ecological status. Actual use increases and ploughlands are overused, which also reduces the capacity.

### 10.2.2 Scenario "B": GreenTech

We envisaged this scenario with a **strong, cohesive community** and a **environmentally-friendly regulatory** system in focus. Community as a driver acted as a basis for our discussions throughout our research while the axis of regulation shaped our scenario at certain points only. The weather factor, which we had identified prior to our workshop as a variable highly likely to occur and modify our scenario, did, indeed, impact it in several places. The driver of climate change appeared during discussions on tourism, livelihood, crop production, housing, landscape use and technology even without any guidance by the moderator. High levels of technological development, another fixed driver besides climate change, also greatly shaped our scenario ands was a pillar of thinking during the discussions of all the topics.

In connection with the GreenTech scenario it can be concluded that it is characterised by increased welfare and well-being primarily due to the fact that a strong community controls and actively guides life in the Niraj and Târnava Mică region: "a strong community can regulate what they need".

People's livelihoods are better compared to 2016 conditions due to the cumulative effect of several factors. Agriculture receives a boost, and, within in it, small-scale, self-sufficient farms become prevalent. Families strive to produce as much as possible themselves and sell surplus locally, creating thriving barter and great demand for healthy, locally grown products. At the same time, farmers' collective efforts enable them to break into external markets thus producing some of their locally grown goods for global markets. Greater importance is given to small and middle-size enterprises which are involved in the service sector mainly and are based on traditional professions: hairdressing, watch-making, and shoe repair become sought-after services. The third pillar of livelihood is industry albeit in a smaller proportion than the two previous sources of livelihood. Industrial production also moves in a different direction. Industry impacts the environment to a much lesser extent due to the serious measures introduced by green regulation. Higher technological levels ensure a more efficient functioning of industry and much less pollution. Production of new products is increasingly replaced by recycling. Industry is based on the processing of agricultural products, and the related production of machinery and fertilizers observes the principle of sustainability. Polluting industries and the production of chemicals and pharmaceuticals are subject to strict rules, and the use and production of harmful materials (heavy-duty chemicals) retreats.

During scenario building, the issues of whether greater technological development will replace live manual work and what role machines will play during agricultural activity were left open. It is conceivable that machines will increase the distance between man and nature. The conclusion pertaining to this topic was the following: it is difficult to find the borderline within which technology still serves a community's interests, which is why technological development and machine use need to be actively controlled.

**Tourism** is a key source of livelihood in the Niraj and Târnava Mică region in 2040. Since the regulatory system is beneficial to enterprises, their number increases in the field of tourism, too. Tourism relies heavily on showcasing local traditional customs and religious practices, on describing the built environment and, above all, providing insight into to local natural assets. Changes are envisaged by participants in typical destinations and tourism activities: due to the changed climate, summer activities may be transferred to autumn and higher altitudes. This is especially true for skiing, which can only be practised only in higher mountains compared with 2016 conditions. At the same time, it is easy to foresee that skis will be replaced with wheels which can be used to slide on grass surfaces, too.

However, the community keeps firm control of the number and composition of tourists. It rejects mass tourism, preferring soft tourism instead. Because local people try to preserve the calm atmosphere of villages and their natural assets, they refuse to allow hordes of tourists to flood the region. The local community uses communications technology to promote their tourism potential more efficiently.

GIven that the population does not face serious livelihood problems, and they have a good community life, **population** increases in the country. There is vibrant community life, with, for instance, sports communities, choruses, and groups preserving folk traditions, thus young people are happy to stay in their native villages. People's general health condition improves because they consume healthy, locally grown produce, drink cleaner water due to higher levels of technological development and reduced pollution. In addition, they also lead more stress-free lives. Thus, mental and psychological well-being also contributes to physical well-being. It remains to be seen, however, how the human body will react to higher temperatures and extreme weather patterns.

Community life is strongly determined by unwritten moral codes. The centre of people's lives is occupied by community cohesion and community interests, and although these people are accepting and inclusive (in relation to, e.g., ethnicities), they can easily turn discriminative towards those who are unwilling to observe the community's unwritten codes. In connection with this question it was controversial whether a cohesive community behaves in an inclusive and constructively supportive way towards norm-breakers or tries to affect others using discrimination. For instance, how it handles people who fail to attend important community events or fail to keep their house in order. (At the beginning of the discussion, it was the Roma who were mentioned as a possible norm-breaking minority, but participants later changed this to "people living in ways unacceptable to the community".) There was, however, agreement that the community's values were core values and that they tried to use even external factors like technology in a clever way, keeping the community's interests and goals at heart. One such example was the communication and promotion of the importance and benefits of folk traditions. The Roma population is not growing, and as long as they can adapt to the community's norms, by which they mean not the majority's religious and cultural customs but rather an organized way of life, the local community will be undiscriminating towards them.

**Landscape use** is primarily characterised by sustainability and awareness. Agricultural production mostly takes place on small-scale farms that sustain and preserve natural assets. Lands are owned partly by the community and partly by private entities. The farmers effectively engage in cooperation, which manifests itself in establishing cooperatives, the joint use of agricultural machinery or the practice of voluntary working in teams currently enjoying a revival. Another sign of cooperation is that farmers join forces to acquire raw materials and to break into markets. Farmers find preservation of local and native plant and animal species important but are also choosing heat and drought tolerant

species that adapt to the changed climate conditions. Thus, in choosing species for use in agriculture, hotter **climate** is an important factor. Moisture-loving species are highly likely to disappear. Participants did not specify species; instead, they said that they would keep “more efficient” (more productive) ones. At the same time species selection also receives an important role: people use the species that have proven to be easy to work with, and are drought and heat tolerant. Although genetically modified species will probably spread all over the world due to technological development, people living in the Niraj and Târnava Mică region reject them.

Water replacement and irrigation will be necessary as the local community faces water shortages primarily due to desertification. The latter will be realised by drip irrigation systems on the ground rather than sprinkling from above to minimise evaporation and large water loss. In order to regulate local climate, the community places great emphasis on preserving woods and preventing desertification. To this end, they use plants covering the ground, and, through the cooperation of several villages, preserve and store local precipitation. Preservation and maintenance of wetlands also becomes an important pillar of climate change adaptation.

Developed **technology** can hide numerous dangers but the local community uses strong control over these tools as well. The community strives to use technology to preserve environment health and promote an environmentally friendly way of life supported and stimulated by green regulation. Accordingly, the region is characterised by more efficient sewage treatment and transport that is less damaging to the environment. Developed technology contributes to welfare: there are well-equipped surgeries and schools in the region. Transport is also characterised by efficiency. There are not many roads, but the existing ones are of good quality. During road constructions, engineers take ecosystems into account. The means of transport do not damage the environment.

Since agriculture is characterised by small-scale farming, **the landscape** is not characterised by large coherent areas or monocultures. As a result, there is more greenery and greater biodiversity. There are fewer ploughlands as production is more efficient. There are borders and field margins, or ecological corridors between landscape parcels. The composition of forests by tree species remains unchanged because the present species will be able to cope with the 1-1.5 degree increase in the temperature but they will spread north. At lower altitudes, steppes are typical. Forests comprise mostly native tree species. In the natural forests people pick berries, mushrooms and herbs in larger numbers than today. Beekeeping remains an important activity in the Niraj and Târnava Mică region in 2040, too. Although new more invasive species appear due to climate change, small-scale farming and the cohesive community can prevent them from spreading. If these invasive species turn out to be useful, local people will use them, making sure they do not cause any damage to people’s health or the environment. Although there are wetlands in the region, droughts make water storage necessary, solved by smaller storage facilities. In addition, natural water retention through habitats (woods, grasslands) receives an important role. Old river beds are restored.

In terms of habitats, there will be more grasslands compared with today’s conditions, and consequently, there will be more grazing animals, too. Because of the greater size of grasslands under- or overgrazing will not present a problem, and animals will graze in proper distribution. Although “villagers are happy to have black locusts around”, these woods will likely decrease in territory as the local community realises that black locust hampers efforts in environmental protection.

Ploughlands, grasslands and woods show an even distribution in the region. Ratios were determined using the present conditions in Vărgata.

### 10.2.3 Scenario “C”: Take it and rule

The two ends of the axis that provided a basis for scenario building were a **week community** characterised by a lack of cohesion and a **non-environmentally-friendly regulatory** system. While both drivers featured in the discussions, on the whole, lack of community cohesion was more prominent in the arguments. Interaction of the drivers was also discussed: after some time participants equated rigid and short-sighted regulation with a dictatorial system, which, however, united local communities in the long term (which, in turn, led to positive changes after a time, suggesting that a really dark dictatorship cannot persist).

During the building of scenario “C”, participants had difficulty with the fact that the drivers invited them to use pessimistic thinking and they were not happy to see their own future environment in such a negative way.

In the scenario, **the population** of villages decreases. The deserted villages show skewed ethnic ratios and the proportions of Roma and Romanian people increase (following the example of Transylvanian Saxony). However, rigid regulation restricts emigration, “there is no free movement”. At the same time, the possibility may also arise that tying people to the land somehow keeps the community together. There is no direct regulation concerning people coming to this region to settle from other regions of the country. It is the local community itself that deliberately does not create conditions for this, they are not welcoming and lack of cohesion in the community does not make settlement attractive for incomers. There are no real local leaders, democracy does not work on a local (or on a national level). The development of the region’s settlements is divided; peri-urban localities survive while villages further away from cities are gradually abandoned.

People’s **livelihoods** are dependent on their own potential. There is a lack of community cohesion; each citizen strives to ensure means of subsistence on their own. As a result, a huge gap arises between social classes: a tiny wealthy elite mostly living away from the region holds and controls the majority of the resources, while an impoverished group of the local population are employed as day labourers on their large farms. Also, many people commute to the factories in neighbouring cities. Average living standards are very low; there is considerable unemployment. There is no system of social assistance or when there is, the amount is minimal. Poor people do not have access to resources, as “they would not know what to do with the money anyway”. Poorer layers try to engage in various nature-based self-sustaining activities (e.g, small gardens, collecting wild plants and berries, crafts, and collecting/stealing wood) but their possibilities are limited. Small farms (working on small parcels outside villages) no longer exist. Part of the old knowledge linked to landscape use has been lost by now, although there are a few old people who still possess some traditional knowledge. In connection with the enterprise sector two visions emerged: small enterprises either completely disappear or some remain but the market is dominated by large enterprises and small enterprises can survive on the peripheries only.

The big differences within the community lead to visible changes in **landscape use** as well. Intensive and semi-intensive mechanised production takes place on a concentration of land under large holdings with only sporadic sectors that use manual work (e.g. horticulture ) employing a few local people as day labourers. Agricultural farming involves heavy use of chemicals, making the sector highly damaging to the environment and the soil. Intensive chemical use makes the waters contaminated, the rivers’

water flow decreases remarkably due to regulations, irrational water management and climate change.

The species composition of the plants grown in the region changes but it is uncertain in what form. Landscape use is not consciously planned and does not represent public interest. Those with smaller power are unable to build their own farms as they do not have access to natural resources, mostly land. Commonages retreat or disappear completely.

In terms of forests the the main objective is greatest possible logging, thus short rotation times are used in their cultivation, completely disregarding functions of protection and public welfare. Woods that were formerly in the hands of smaller owners have by now been transferred to owners of large holdings while those that are still part of commonages are highly likely to be transferred into the hands of large holdings (as soon as commonages retreat).

Large pieces of land change hands quickly, as soon as a large landowner dies, another one takes their place. In order to secure their livelihood, “little people” keep backyard plots and sometimes go foraging in nature. Collecting wild plants and mushrooms is also centralised, large collecting plants employ their own people to harvest wild plants.

Dominated by large homogeneous fields, the landscape is no longer fragmented. Natural habitats are replaced by scattered pensions and solar power plants as those in power can build anywhere, circumventing rules.

**Temperature increase** and **desertification** lead to the appearance of new invasive species, pests, and pathogens. New, originally southern species (e.g. sweet potatoes, rapeseed) with lower water demand spread across farmlands. In livestock breeding emphasis is placed on new species (goat, ostrich), too. There will be considerable damage to forests and the number of pine forests will diminish due to drought. This damage will provide an excuse for further increasing human intervention (shorter rotation times, changes in species, e.g.: Paulownia).

With natural assets (landscape, village scape or healthy environment) largely lost to intensive agriculture and mechanisation and loss of traditions, tourism does not play a key role. It has been suggested that neighbouring countries may also display a closed attitude, so little emphasis is placed on international tourism. Domestic tourism may survive, since local people also have recreational needs. Far fewer people live off tourism, and there are fewer pensions and catering places. There are the occasional hotels to receive guests, centrally located. The region is visited only by those groups of tourists who wish to experience the mysterious emptiness of abandoned villages or come back feeling nostalgic.

The **landscape** is no longer fragmented, is dominated by monocultures and its monotony is broken only by scattered buildings, ruins, and industrial plants. Environmental protection and nature conservation practices are not common.

Intensive monocultural production with a high environmental impact takes place on large parcels with a heavy use of agro-chemicals. In the garden plots, “organic through necessity” is typical (but those who have access to it spray their crops with pesticides unwisely). The composition of the species grown shifts towards species functioning well even among the new climatic conditions. The total area of agricultural lands does not increase (due to terrain limitations), but some of the areas that are under small parcel cultivation today or partially abandoned engage in industrial production. Another, hard-to-cultivate portion of the abandoned small parcel areas is transformed into forests.

There is considerable livestock breeding in the landscape. Larger animals (sheep, cattle, but increasingly also goats), are owned by large-scale farmers, while poorer farmers keep small animals in their garden plots: this is subsistence livestock breeding). Grasslands are heavily overgrazed, with no encroached grassland? or abandonment. A share of the encroached areas were transformed into woods. There are large, coherent grasslands (pastures) covering entire hillsides.

Natural forests decrease in size but on the whole the proportion of forests does not change as new woods need to be planted due to climate change and because degraded areas cannot be used for anything else. However,in these places fast-growing tree species are planted, e.g., black locust. Afforestation takes place on orders from the government. Climate change also causes serious damage to woods and devastation (new pests, fires). The natural condition of woods has declined greatly.

Wetlands decrease in size and disappear in many places, which can only partially be attributed to climate change. People do not use water consciously; water is wasted, leading to more serious water shortage. Smaller streams dry up or their water flow declines, and they become seasonal. The quality of rivers, lakes, and streams greatly deteriorates.

The highway construction is finished and fragmentation due to road network increases significantly. There are other landscape wounds, too (mines, landfill sites, and industrial investments).

The size of woods and grasslands somewhat increases, while that of ploughlands is similar to today's conditions.

### 10.2.4 Scenario "D": Opportunity in unity

In the scenario "Opportunity in unity", that is based on the two endpoints of the axes with a **stable, cohesive community** and a **non-environmentally-friendly regulatory** system, the region's **population** increases, primarily due to the fact that many who have previously emigrated return. Changes take place in the composition of the population, too. The proportion of the Hungarian population is not going to increase while that of the Roma population is (based on 2016 demographic indicators). Average living standards increase, and social disparities decrease. Old people live active lives, supported and included into everyday activities by a cohesive community. Scenario builders were divided over whether it will be an aging society or not.

People are healthier because of the cleaner country air and less pollution, the environment is cleaner, and the pharmaceutical industry is also developed, facilitating treatment of diseases. Developed technology offers numerous opportunities, and more and more people gain access to this technology, making proliferation of information easier. Life, however, is basically more fast-paced, hence people are more stressed.

The region's economic situation is stronger compared with 2016 conditions. Some people work in production, others in the service sector but there are also some who commute to nearby cities to work there as there are limited opportunities to work locally. There is some unemployment, although lower than in 2016.

**Livelihoods** are essentially based on local raw materials, largely due to the fact that people can join forces and achieve what they want. An increase in the number of small and medium-sized enterprises

reduces the region's development gap. The tourism sector also develops. The middle class is the strongest social group. Incomes can be regarded as average.

**Landscape use** is much more subject to grey regulation than changes in the local population or livelihood. Land ownership changes: on the one hand, lands are in the hands of local large farmers, who grow bigger and bigger through land purchases, on the other hand, there are also cooperatives that are created through smaller farms joining forces. The ratio of ploughlands decreases, but on the whole, larger parcels are typical, where intensive production takes place. On the hillsides extensive farming (fruit or grassland) takes place. The proportion of grasslands increases, as areas unsuitable for crop production on ploughlands are also reversed to grasslands. As a result, the number of animals also increases. Compared with previous periods, there are more orchards, too. Grey regulation supports more efficient production, resulting in mechanisation in agriculture.

Natural habitats and wetlands shrink. High energy demands require the construction of hydroelectric power plants designed to generate energy from surface waters. Water is also necessary for irrigation purposes. The population faces inadequate availability of water both in terms of quality and quantity (e.g., continuous drying-up of surface water flows), which can be alleviated through increasing water use effectiveness. People try to manage the problem by exploiting deep-water sources. Due to the water shortage drinking water and other kind of water use become separated from each other. People use water suitable for drinking for consumption only, while they use reused or locally cleaned water to satisfy other household water needs (e.g. washing, irrigating). In order to decrease the water problem, great emphasis is placed on education to promote economical and proper water use.

Fast and comfortable transport is important to people, leading to the development of infrastructure. During road constructions, grey regulation prefers efficiency and cost-efficiency, as a result of which fragmentation due to road networks increases. The strong local community strives to intervene in the constructions that impact nature negatively by protesting against them. Although there are more asphalt roads and cars, due to a greater number of electric cars, there is less environmental impact. However, use of public transport is still not promoted, instead, car/individual transport is popular. People obtain food from local markets; what is more, even town dwellers develop a demand for healthier food, as more and more people obtain their food from the country. People buy non-food products from external sources through the Internet. Industrial production is not typical, it is present sporadically only, because labour is expensive here (compared to China, e.g.) and it is not worth building factories here.

**Tourism** is built on local features: in towns people tend to visit swimming pools, while in the country they tend to be interested in natural assets. Tourism is basically nature- and education-based. Middle-class tourists mainly come from Hungary and Western-Europe. A proportion of farmers develop agrotourism businesses.

There has been no considerable change in the **landscape**. The total area occupied by grasslands increases slightly, but the grass harvested per hectare shows a slight decrease due to dry weather. A share of earlier encroaching grasslands has been cleared, while another share has been turned into forests.

The size of the area occupied by woods has not changed compared to earlier conditions, but the share of planted pine forests may decrease due to climate change. Due to drought caused by climate change the area covered by deciduous woodland may shrink, too, with black locust becoming more prevalent.

There is no considerable change in the amount of wood and timber. Although the weather is drier, the annual tree growth rate lengthens due to hotter climate.

On the whole, ploughland areas decrease, but larger ploughland parcels become the norm. This region is suitable for fruit-growing, thus the number and size of plantations increase. The road network is more extensive, leading to fragmentation. Barren areas and hillsides occur due to climate change. The region is characterised by overgrazing, but it does not increase considerably because strong communities and local farmers will supervise the long-term management and maintenance of grasslands (locals will not quit when farming is no longer profitable), as their livelihoods depend on them.

Beekeeping faces difficulties due to the hotter climate. Honey production may decrease on a regional level although this is by no means certain. Grey regulation does not affect the success of honey production.

Collecting wild plants and mushrooms will be far more controlled in 2040, with small enterprises growing berries, reducing demand for wild plants harvested from the forest. The amount of wild fruit on grasslands decreases (as the size of encroaching grasslands decreases), while berry bushes in woodlands are drought tolerant, thus the amount of their produce does not decrease. The number of edible mushrooms decreases due to drier weather. The diversity of herbs decreases but their number remains unchanged.

There will be no decrease in the number of tourists in the region, instead, it will show an increase compared with other regions. Since there is an extensive road network at people's disposal, many tourists will tour the countryside by car but there will also be backpackers.

With regard to the ratio of habitats, grasslands occupy the largest area, followed by a slightly smaller area of woods. The ratio of ploughlands has decreased compared with 2016 conditions.

## 10.3 Scenario valuation

In evaluating the scenarios, we sought answers to the questions of how the well-being of various social groups will differ in each scenario. The evaluation of the scenarios was carried out in two steps.

The first step, **scenario quantification**, was to provide quantitative probability estimates with the help of the ES capacity models used for mapping the ecosystem services (see *Chapter 7.2*), as well as local expert opinions on how the share of the region's main habitat types and the availability of the examined ecosystem services might change under the different scenarios.

For the second step, the **deliberative valuation**, we invited again local people's opinion on how the imagined scenarios might effect the well-being of different social groups. This was evaluated based on the ES capacities calculated in the previous step and their possible effects on society, as well as on the storylines developed.

### 10.3.1 Scenario quantification - Quantifying ES in the scenarios

With quantifying scenarios we aimed to predict the future implications of the different storylines on the different ES. According to the logic of the simple matrix models (see *Chapter 7.2.1*), the overall ES supply over an area depends on two 'factors':

- the ES supply capacities per unit area (or 'unit capacities') of the different habitat types,
- and the total area of each habitat type in the study region.

During the scenario quantification exercise we analysed the potential changes in these two factors in the four scenarios with respect to all ESs studied in a structured way. The area proportion of the different ecosystem/habitat types can relatively easily change in the future as a consequence of alterations in human preferences or patterns of natural resource exploitation. Unit capacities, however, can be considered to be much more stable than habitat areas, yet they still might change due to changes in land use practices (e.g. intensity of chemical use, grazing practice, etc.).

To be able to apply the ES capacity models to the future scenarios we first created summary tables to all four storylines resulting from the scenario building process. The storylines were carefully analyzed by the participating researchers with respect to 16 key factors and characteristics. This table is supposed to express a concise, coherent and detailed semi-quantitative overview on the key differences between the individual scenarios, keeping in mind the coherence, consistency and plausibility of the whole set of scenarios, thus facilitating the understanding and consensus in terms of potential future area proportions ('area ranges') of the individual habitat types.

Furthermore, we also analysed the scenarios in terms of foreseeable changes in unit capacities. We used the outputs of the matrix workshop (matrix scores, see *Chapter 7.3*) for such events, as these values reflect the local experts consensus on the actual relative average ES supply capacities of the different ecosystems. All changes not captured by the percentage changes of land cover, but deduced from the scenarios could be integrated here (e.g. more intense application of pesticides – resulting in less favourable conditions for bees in some habitats, therefore lower ES scores for these regarding the ES honey/nectar).

The key step of scenario quantification was a small dedicated expert workshop with the goal of estimating probable 'future area ranges' for the 13 main habitat types, and translating these ranges to ES supply changes based on the simplest versions of the ES supply models (matrix models, Tier 1) developed in Chapter 7. We used ScenQuant, a dedicated participatory tool developed at MTA ÖK (Czúcz et al. 2016), to generate ES predictions for the four scenarios in an iterative, transparent and participatory process (**Fig. 10.2**). ScenQuant is created for generating ES predictions starting out from scenario narratives and a simple matrix model. The tool can estimate the future availability of the modelled ES averaged for the whole area. Using estimated cover percentage ranges of each habitat type and (adjusted) matrix scores, the tool takes a high number of random samples (from the multidimensional simplex subspace of the area ranges), and applies the matrix model to each of them, thus creating a probabilistic prediction of the studied ES in a few seconds. This enables instant feedback to the workshop participants, making it possible to explore and adjust the future area ranges in an iterative way until consensus is reached. ScenQuant furthermore constantly takes account of several 'integrity criteria' during the iterations (e.g. the sum of all habitat areas must always cover the entire study area).

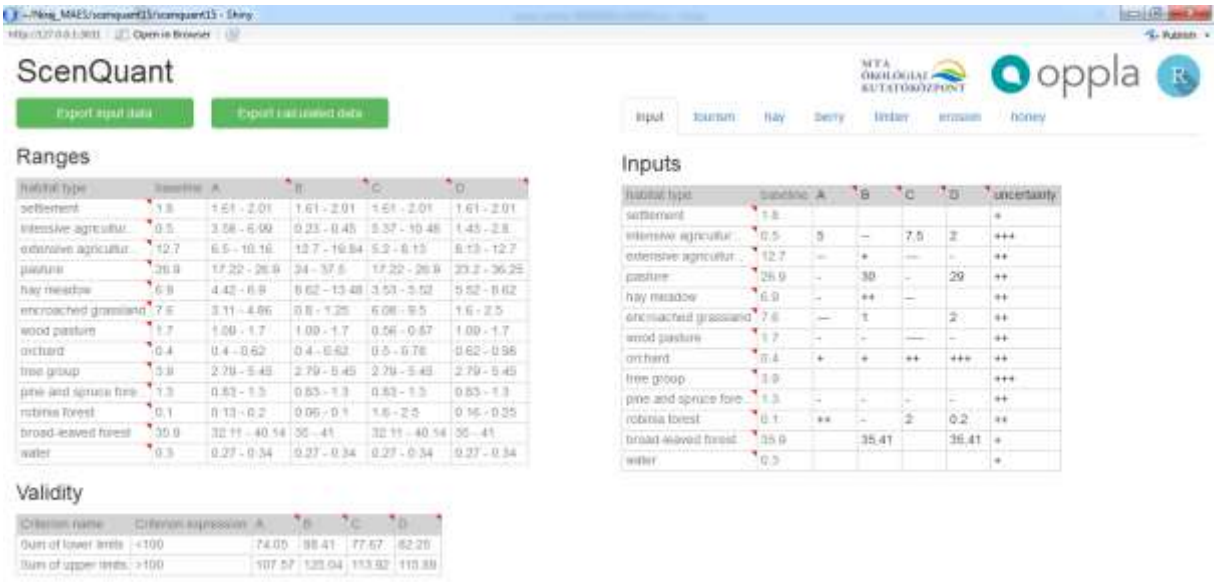


**Fig. 10.2:** Example for estimating habitat type ranges for each scenario in ScenQuant. The figure shows a screenshot of the ScenQuant tool calculating the expected ES-scores based on the estimated ranges of land-use/habitat types with the input data shown on the right side.

The expert workshop followed the following workflow:

1. **Review of storyline summaries**: The scenarios, the summary table and the proposed ES matrix score adjustments were presented to the experts in detail. The experts then surveyed the summary table first, suggesting changes to integrate additional relevant local experience (e.g. historic perspectives of the locals). Changes were discussed thoroughly and finalized keeping both consistency and local authenticity in mind, the finalized consensus summary table is presented in (**Table 10.1**).

2. **Estimate habitat area changes**: Future area ranges of the habitat types were estimated directly in the ScenQuant software. The ScenQuant interface makes it possible to propose habitat area changes in a flexible way, both as 'absolute' values (e.g. as "15-20% of the total study area") or as relative values (e.g. as "+10% increase compared to the current (=baseline) situation, with an uncertainty of +-2.5%"). As relative values are much more intuitive, they were generally favoured by the participants. The experts iteratively refined their proposals, and they relied on the summary table a lot during this iterative process. A typical ScenQuant screenshot is shown in **Fig. 10.2**. ScenQuant instantly translates the relative ranges to absolute ranges, supervises the relevant integrity criteria, and gives feedback on the predicted "ES supply spectrum" of the scenarios on request, thus allowing for an efficient and transparent expert work.

3. As a next step the experts surveyed and discussed the changes proposed to matrix scores, and adjusted the matrix values, when they felt it necessary. A concise extract from the consensus **matrix score adjustments** can be seen in **Table 10.2**. For any score change a clear justification was necessary, which had been recorded (**Table 10.3**).

**Table 10.1:** The key factors and characteristics driving future land use and human-nature interactions in the four scenarios (the number of "+" and "-" signs shows how characteristic or un-characteristic the actual factor is for the given scenario)

| | | **scenarios** | | | |
|---|---|---|---|---|---|
| | | **A - As helpful as kissing frogs** | **B - GreenTech** | **C - Take it and rule** | **D - Opportunity in unity** |
| **factors** | **local society** | unstable, diverging | stable, cohesive | unstable, diverging | stable, cohesive |
| | **type of regulation** | environmentally friendly | environmentally friendly | not environmentally conscious | not environmentally conscious |
| self-sufficiency | | **--** | **++** | **-** | **+** |
| automated/intensive farming with pesticide use | | **+** | **--** | **+++** | **+** |
| property/land monopolisation/concentration | | **++** | **--** | **+++** | **+** |
| patchiness | | **-** | **+++** | **--** | **+** |
| (farm) animal/livestock numbers | | **+** | **+** | **+** | **+** |
| grazing (overgrazing/low grazing pressure) | | **+** | **--** | **++** | **-** |
| population growth | | **-** | **+** | **--** | **+** |
| standard of living | | **-** | **++** | **--** | **+** |
| social differences | | **++** | **--** | **+++** | **-** |
| conscious usage of water | | **+** | **+++** | **--** | **++** |
| water quantity | | **--** | **-** | **---** | **--** |
| water quality | | **-** | **+** | **---** | **-** |
| nature conservation intention | | **+** | **+++** | **---** | **+** |
| fragmentation by roads | | **+** | **+** | **++** | **++** |
| spread of invasive species | | **-** | **--** | **++** | **+** |
| quality of forests | | **+** | **+** | **--** | **-** |

**Table 10.2:** Overview of the proposed ES score changes in the different scenarios based on the established rules. ***** column indicates present scores (baseline), where grey marks show changes, while in columns A-D the new scores and the direction of score changes (decreasing scores reddish fill, increasing scores greenish fill) are shown for the scenarios A-D.

| | Timber | | Natural forage and fodder | | | | | Wild plants and mushrooms | | | | | Honey | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *, ABCD | | * | A | B | C | D | * | A | B | C | D | * | A | B | C | D |
| settlement | 1 | | 3 | 3 | 3 | 3 | 3 | 6 | 6 | 6 | 6 | 6 | 4 | 4 | 4 | 4 | 4 |
| intensive agricultural | 1 | | 2 | 1 | 3 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 3 | 1 | 2 |
| extensive agricultural | 1 | | 5 | 5 | 5 | 5 | 5 | 6 | 6 | 6 | 6 | 6 | 4 | 5 | 7 | 3 | 5 |
| pasture | 1 | | 9 | 9 | 9 | 9 | 9 | 9 | 7 | 9 | 5 | 9 | 5 | 3 | 5 | 3 | 5 |
| hay meadow | 1 | | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| encroached grassland | 2 | | 5 | 5 | 5 | 5 | 5 | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 |
| wood pasture | 3 | | 9 | 9 | 9 | 9 | 9 | 10 | 9 | 10 | 9 | 10 | 5 | 3 | 5 | 3 | 5 |
| orchard | 2 | | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 9 | 8 | 9 | 5 | 8 |
| tree group | 4 | | 6 | 6 | 6 | 6 | 6 | 7 | 7 | 7 | 7 | 7 | 9 | 9 | 9 | 9 | 9 |
| pine and spruce forest | 6 | | 1 | 1 | 1 | 1 | 1 | 6 | 6 | 6 | 6 | 6 | 3 | 3 | 3 | 3 | 3 |
| robinia forest | 8 | | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 3 | 10 | 10 | 10 | 10 | 10 |
| broad-leaved forest | 8 | | 2 | 2 | 2 | 2 | 2 | 7 | 7 | 7 | 7 | 7 | 4 | 4 | 4 | 4 | 4 |
| water | 1 | | 3 | 3 | 3 | 3 | 3 | 4 | 4 | 4 | 4 | 4 | 5 | 5 | 5 | 7 | 6 |

| | Water retention and soil erosion | | | | | Touristic attractiveness and local identity | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | * | A | B | C | D | * | A | B | C | D |
| settlement | 0 | 0 | 0 | 0 | 0 | 9 | 5 | 9 | 9 | 5 |
| intensive agricultural | 4 | 4 | 4 | 4 | 4 | 2 | 2 | 2 | 2 | 2 |
| extensive agricultural | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 8 | 6 | 7 |
| pasture | 6 | 5 | 6 | 4 | 6 | 6 | 6 | 6 | 6 | 6 |
| hay meadow | 10 | 10 | 10 | 10 | 10 | 6 | 6 | 6 | 6 | 6 |
| encroached grassland | 7 | 7 | 7 | 7 | 7 | 4 | 4 | 4 | 4 | 4 |
| wood pasture | 7 | 6 | 7 | 5 | 7 | 9 | 9 | 9 | 9 | 9 |
| orchard | 9 | 9 | 9 | 9 | 9 | 8 | 8 | 8 | 8 | 8 |
| tree group | 9 | 9 | 9 | 9 | 9 | 7 | 7 | 7 | 7 | 7 |
| pine and spruce forest | 10 | 10 | 10 | 8 | 10 | 7 | 7 | 7 | 7 | 7 |
| robinia forest | 9 | 9 | 9 | 7 | 9 | 5 | 5 | 5 | 5 | 5 |
| broad-leaved forest | 10 | 10 | 10 | 9 | 10 | 10 | 10 | 10 | 10 | 10 |
| water | 8 | 8 | 8 | 8 | 8 | 9 | 7 | 9 | 5 | 7 |

**Table 10.3:** The justifications for the proposed changes in unit capacities (matrix score changes) presented in **Table 10.2.**

- for natural forage and fodder ES:
  - if intense use of chemicals ->"intensive agr.areas" even less favourable (=lower score)(scenarios A,C), if greener use -> higher scores for this category. (scenario B)
- for wild plants and mushrooms:
  - if overgrazed pastures and wood pastures -> score for herbs, mushrooms and berries lower (scenarios A,C)
- for honey and nectar:
  - if intense use of chemicals ->"intensive agr.areas" even less favourable (scenarios A,C) (=lower score), if greener use -> higher scores for this category (scenario B)
  - if greener intentions -> "extensive agr. areas" gain higher score, if more industrialization (scenario C), lower scores
  - if overgrazed pastures and wood pastures -> less diverse flowers for bees, score lower (scenarios A,C)
  - if intense use of chemicals ->"orchards" less favourable, lower score for scenarios A,C (no changes introduced for greening, as score already rather high (9)
- for water retention:
  - if overgrazed pastures & wood pastures -> less soil&water retention (=lower score)
  - if more intense use of forests (more frequent loggings) -> less soil & water retention (=lower score)
- for touristic attractiveness ES:
  - if community unstable -> lower attractiveness(=lower score) of "settlements" (less well kept) (scenarios A,C)
  - if greener intentions -> "extensive agr. areas" gain attractivity (=higher score), if more industrialization (scenario C), less attractive (=lower score)
  - if water quality worse -> "water" less attractive (=lower score) (scenarios C, A and D)

When the experts arrived at a consensus on the probable future habitat area profiles of the study region under the different scenarios, we exported the resulting habitat profiles, the overall ES predictions and their simple visualizations (**Fig. 10.4**) from the ScenQuant tool. The results were briefly discussed, and accepted. The predicted changes in the ES supply and the habitat profile were made ready for their use in the deliberative valuation workshop: habitat profile changes were also depicted in a simplified form for this purpose (**Fig. 10.3**).

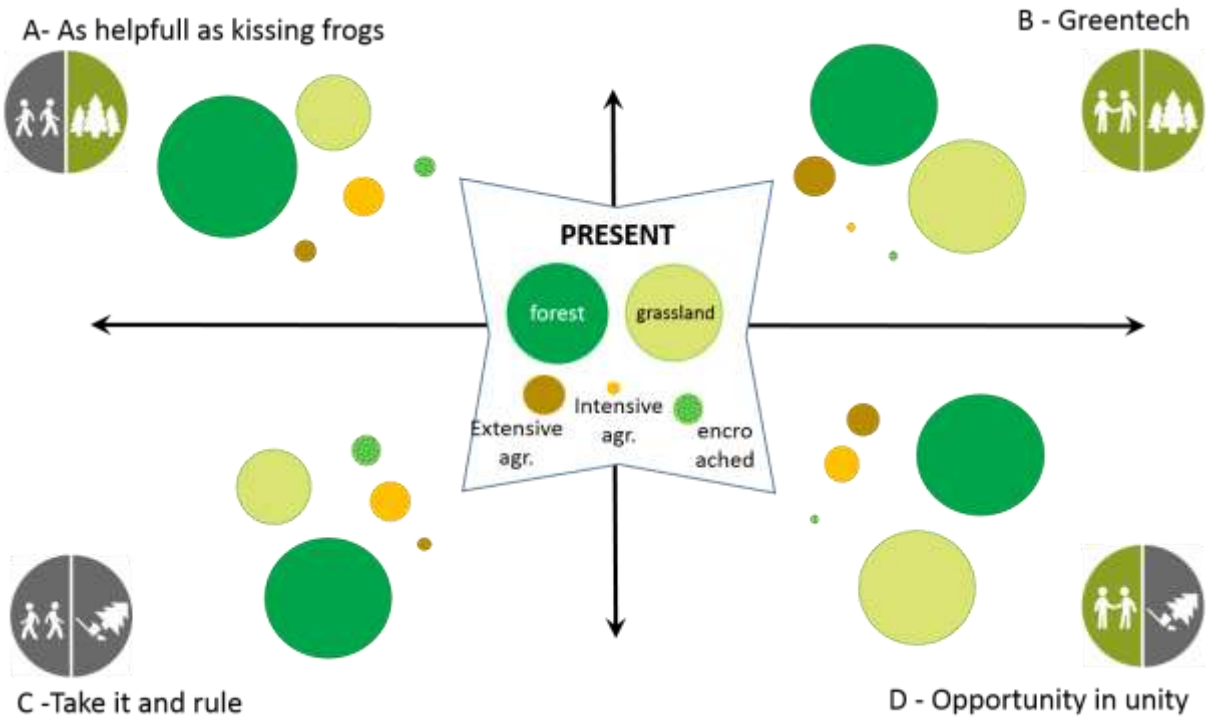


**Fig. 10.3:** Estimated changes of areas of a few (major) habitat types per scenario compared to their baseline (current) state.

Participants of the workshop determined, in four groups of 4-5 apiece, which social groups will be winners and losers of the given scenario and what the well-being of these social groups will be like in the given scenario. Evaluation was carried out based on six 'well-being dimensions' supported by the literature (Kelemen 2013). These dimensions were as follows: livelihood, social recognition, physical health, mental and spiritual health, being a member of a community, safety and public safety.

In possession of the storylines, the habitat and ES profiles of the scenarios, we invited a new group of local stakeholders who were not involved in the scenario planning process. The aim of the scenario evaluation workshop was to explore how the well-being of different social groups would be shaped by each scenario.

Haines-Young and Potschin (2013) define human well-being as free access to the elements of good life such as freedom of choice and activity, healthy life, good human relationships and safety. But how can human well-being be connected to ecosystem services? According to Haines-Young and Potschin, ecosystem services directly create benefits that contribute to human well-being. But this does not mean that human-well being uniquely depends on the quantity of ecosystem services available. Other external factors, such as political or market circumstances also affect the level of well-being.

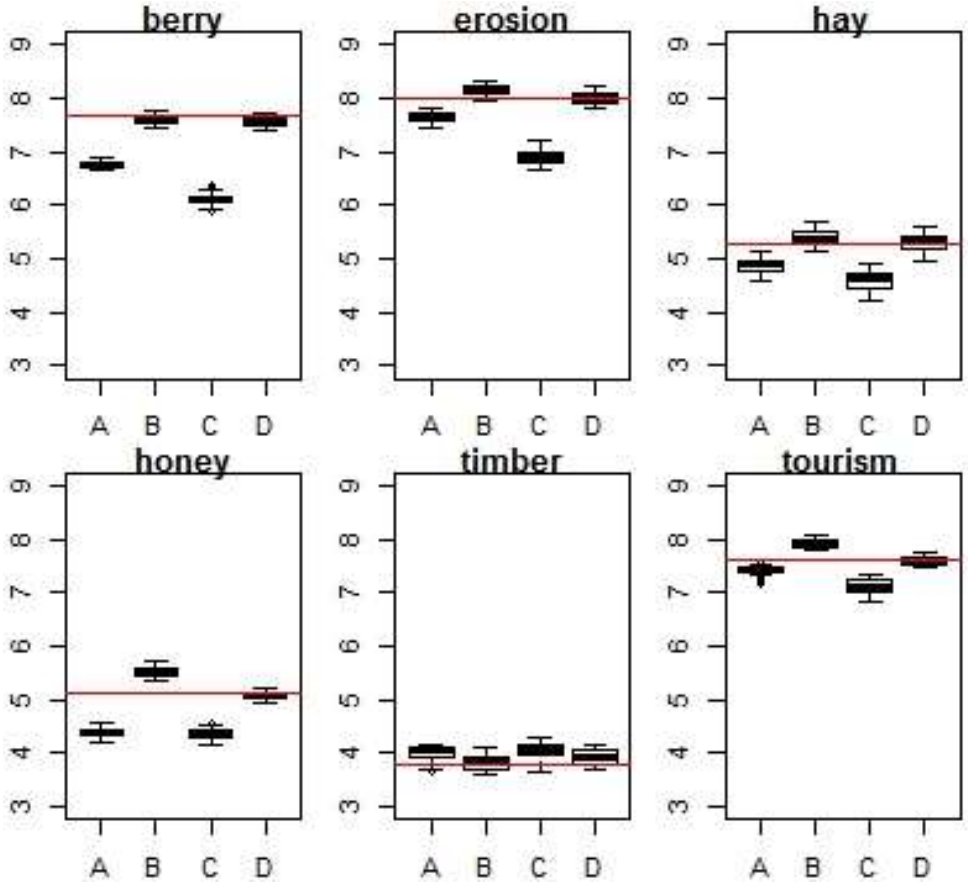


**Fig. 10.4:** Examples of ES score-boxplots for scenarios showing average supply capacity of the whole area. Middle-line in box shows median of ES score estimate, red line shows baseline (present situation), the length of the whiskers represents the uncertainty of estimates.

The literature distinguishes many classifications of well-being dimensions. Based on the works of Maslow (1970), Prescott-Allen (2001) and Nussbaum (2010), we created our own simple classification for the purposes of the planned deliberative scenario valuation. Our most important organizing principles were: conceptual simplicity, a relatively straightforward connection to ecosystem services, and local relevance, which altogether, as we hoped, could make this classification useful in the planned workshop context:

- **Livelihood:** People live without financial difficulties (but excluding extreme wealth)
- **Social appreciation, acknowledgement of work:** People feel themselves and their work being useful and appreciated, which creates social status.
- **Living in community**: People feel to belong to a community, there is a richness of human relationships**.**
- **Physical health:** People have a healthy lifestyle, that affects physical health; there are few diseases.
- **Spiritual and mental health:** People are well-balanced, they have a healthy and active mind**.**
- **Safety and public safety:** People feel safe, good public safety.

Workshop participants were divided into four groups of 4-5 persons, one group for each scenario. After a detailed presentation of the scenarios, each group had to identify which social groups will be winners and losers of the given scenario and what the welfare of these social groups will be like in the given scenario. Participants of the groups collected an average of 20 different stakeholder groups. As the

workshop did not allow for a detailed analysis of the well-being of each stakeholder group, the participants were asked to select three stakeholder groups each from the winners and losers, which they would evaluate in the further stages of the workshop. These groups are listed in **Table 10.4** sorted into the categories of winners and losers in each scenario.

**Table 10.4:** Results of the evaluation of different social groups' well-being in the four scenarios.

| | **Winners** | **Losers** |
|---|---|---|
| "**A" – As helpful as kissing frogs** | Foreign investors, multinational companies | Population of small villages |
| | Local large-scale farmers (cattle breeders, crop producers) | People employed in tourism |
| | Roma community | Natural environment |
| "**B" – GreenTech** | Locals: children, elderly, youth | External (foreign or non-local) investors |
| | Tourism providers, tourists | Multinational companies |
| | Natural environment | Farmers using intensive practices |
| "**C" – Take it and rule** | Large-scale farmers | Hobby farmers |
| | Industrial investors | Population of small villages |
| | "Survivor", persistent small-scale farmers | Children |
| "**D" – Opportunity in unity** | Small-scale farmers | Workers |
| | Emigrants returning to the region | Organic farmers |
| | Population of small villages | Small-scale cattle breeders |
| | People employed in tourism | |
| | Large-scale cattle breeders | |

The table above shows that different participant groups independently of one another in many cases selected the same stakeholders as the most important ones in the region. Small-scale farmers were regarded as the most important stakeholders by two groups ("C"; "D" scenarios), the natural environment also by two groups ("A"; "D"), and those involved in tourism (tourists or people employed in the tourism sector) were selected by three groups ("A"; "B"; "D"). Multinational companies and foreign investors were selected by three groups ("A"; "B"; "C"), too. The population of small villages/locals and the intensive or large-scale farmers were considered key stakeholders by all four groups. While the classification of stakeholder groups as winners and losers shows a mixed picture, it is nonetheless revealing that these stakeholders were often subjects of discussion.

In the second stage of the workshop, participants evaluated the scenarios in terms of the well-being of the key stakeholder groups. According to the well-being dimensions above, the vast majority of key stakeholder groups were assigned to a zero or positive range in the "B"- GreenTech scenario. This indicates that irrespective of whether a specific stakeholder is viewed as positive or negative by the community, this scenario is regarded as favorable for the majority. In scenarios "A" – As helpful as kissing frogs and "D" – Opportunity in unity, approximately twice as many stakeholder groups were assigned to the positive range as to the negative one. The well-being of stakeholders is the least favorable in scenario "C" – Take it and rule, where almost the same number of stakeholder groups were included in the negative and positive range.

As a conclusion to the workshop, participants selected the scenario they deemed most desirable considering the advantages and shortcomings of each scenario. The choice between scenario "B" –

GreenTech and “D” – Opportunity in unity proved difficult during the discussions. A strong, cohesive community plays a vital role in both scenarios. However, while in scenario “B” it is accompanied by a green, environmentally friendly regulatory system that makes it almost utopist, scenario “D” is characterized by gray, non-environmentally friendly regulation that, albeit being less favorable, seems more realistic. Based on the final decision of the participants, scenario “B” – GreenTech was selected.

## 10.4 Compiling recommendations

Policy recommendations were elaborated with the involvement of the Advisory Board in order to arrive at locally relevant suggestions. In a one-day workshop, results from the scenario development process were shortly presented, while the scenario chosen to be the most desireable (GreenTech) was introduced in detail. Participants were asked to formulate suggestions for policy makers that would make the transition into the desired future possible. The five sectors for which we asked for aiming the policies at were the following:

- agriculture
- forestry
- water management
- tourism
- local governments, NGOs, associations of microregion

Three groups (with three to four persons each) worked each on two sectors in a world café (Gáspár et al. 2014) arrangement, changing after 25 minutes to discuss and make suggestions in another groups’ topics. Discussions were helped with directed questions by the moderator, such as:

- The promotion of what kind of agricultural subsidies would be needed in order to realize the Greentech senario?
- What kind of water management would be needed so that there is conscious handling of water while climate is getting drier, as in Greentech?

Finally, all recommendations were collected in a plenary discussion.

Recommendations were screened, summarized and combined with knowledge on the general policy environment (*see Chapter 3*) to make concrete policy briefs for the concerned sectors outlining the present state of each sector, the provided services and the proposed measures to achieve the future scenario envisaged (*see Chapter 11.3*).

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# 11. Synthesizing results from the mapping and assessment of ecosystem services in the Niraj - Târnava Mică region

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In the following chapter we will overview the results of the whole process of mapping and assessing ESs in the Niraj - Târnava Mică region, show their implications and set these into local context, as well as point out some international relations.

First, in *Chapter 11.1*, we summarize how local stakeholders valued the various ESs in the region concluding on the results from the preference assessment (*Chapter 6.1*) and the survey on local businesses (*Chapter 9*). In the last part of this section (*Chapter 11.1.3*), we summarize the results from the scenario building process, showing which of the developed scenarios participants chose as the most desirable future. In *Chapter 11.2* we then give an overview of the values assigned to the chosen services through the different perspectives and methods and then synthesize these aspects to cover each ES in sequence, expanding on locally relevant issues (and setting them in relation to international experience/results). Finally, in *Chapter 11.3* we present the recommendations we arrived at analyzing the policy environment and seeing the issues surfacing during Advisory Board meetings, interviews, which need to be implemented in order to achieve the desired future scenario.

## 11.1 Stakeholder perceptions of ESs in the present and the future

For assessing the preferences of local stakeholders we conducted interviews with local people (*Chapter 6.1*). This preference assessment resulted in a priority list of ESs, which was then further processed in order to establish the final list of ESs that we mapped and assessed. The responses of the interviewees are analyzed in the following section and related to local views and issues.

The dependence analysis of local businesses on the different ESs is the result of a survey with local businesses presented in detail in *Chapter 9*. Here we evaluate results also in relation to the sectoral identity of the economic actors and derive conclusion towards the future of local economy.

### 11.1.1 The importance of the different ecosystem services from the aspect of the population

The ***interviews*** made with local stakeholders reveal that, although local people use a great number of ecosystem services (35 are mentioned in the interviews), they do not really regard them as assets and are not really aware of the vulnerability of these services. People take their existence for granted and begin to appreciate their value only when certain capacities are suddenly reduced. Of the 35 mentioned sevices, **15 are cultural**, which is a rather high rate and suggests that landscape is an important part of local culture: local people are attached to it, treat it as an integral part of their

identity, and natural environment still greatly contributes to their quality of life. Compared with other parts of Europe, people still live as part of the landscape and they have not yet lost the knowledge necessary to do so. This, in turn, can contribute to a relatively good degree of satisfaction with their lives in relation to their financial situation.

In the **preference assessment survey** carried out among the **local population** (**Fig. 6.3**), based on the shortlist of 12 ecosystem services selected by the Advisory Board, **water retention** was deemed the **most important service**. This dominant, first position is probably the combined result of several, partially unrelated causes. One of them is that water represents the basis for life for everybody; another is that issues related to water shortage are common in the media as well, increasing the population's awareness of the issue. More and more streams are becoming temporary in the country, and the much reduced water quantity in the wells poses a serious problem in most settlements. Thus, **water** is the service that **has become especially important in local people's eyes due to its shortage**. In order to tackle problems timely, they need to be addressed before society encounters their shortage as a problem.

**Local identity** was ranked second on the list. Its importance showed no difference across the younger and older generations, which might suggest that emigration from the region has primarily economic causes rather than a lack of attachment to the land on the different generations' part or a preference for other regions. This, in fact, is encouraging, because, in creating scenarios, local people regarded the **cohesive power of the community** as the **key pillar of well-being**, its most decisive factor and simultaneously, the most critical point of their envisioned future. In recent years, community cohesion is drastically decreasing both in larger and in smaller places. The decline of community cohesion needs to be stopped while local identity is still a value for all generations.

The **touristic attractiveness** of the landscape is also among the key services probably because many people in the countryside regard this sector as a breakout opportunity. Despite the fact that a significant proportion of the

population in the research area relies on agriculture for their partial or full livelihood, services tied to the agricultural sector (**natural forage and fodder, soil fertility, and soil erosion control**) took lower positions on the preference assessment of the 12 key services.

A large body of research shows that the biodiversity and the naturalness of the landscape are greatly affected by the mode and intensity of the agricultural activity carried out there (e.g. Benton et al. 2003, Kovács-Hostyánsky et al. 2017, Tscharntke et al. 2005). Changes in farming practices can substantially worsen the capacity of the landscape to provide services, and, as a result, the ecosystem services that people are not yet aware of will gain value as shortages arise (like it happened to water). Once ecosystem services are degraded to an extent at which they have to be artificially replaced, costs are enormous (Allsop et al. 2008, Bastian et al. 2013, Pimentel et al. 1995).

### 11.1.2 The importance of the different ecosystem services from the aspect of the local economic actors

Examining the relationship between ecosystem services and the **region's economic actors**, we asked how important companies deemed the different elements of nature and ecosystem services for the effectiveness of their activity and how dependent they thought they were on them. The answers provided by the companies showed about the same ranking as the one given in the survey carried out

among the local population (with substantial differences only in the valuation of honey and wild plants - both are more important to the population than to companies).

Our results show that for companies, like for the population, good **water** quantity and quality is **the most important service**, a result understandable given the global and local conditions. The companies showed a **high level of dependence on biodiversity**. Half of the sectors examined – those that are more directly involved in land use - ranked biodiversity highest. This reflects a rather high degree of awareness as biodiversity only has an indirect effect on these sectors, and its lack cannot be felt as directly as that of water. Those involved in processing and trade were less likely to tie the success of their enterprise to biodiversity.

**Soil fertility** was ranked very high by companies involved in *agriculture* or *beekeeping*. Surprisingly, though, soil erosion control was not important to them. The strong relationship between these two services is probably less or not at all known to local people. This is also reflected in real life in soil cultivation and grazing practices. Lack of awareness about this relationship reflects a general lack of knowledge in the region in the field of agriculture. To improve this situation, the Advisory Board made recommendations on how agriculture, which is significant on a societal level in the region, could be made more attractive and its standards raised.

There is another issue worth examining: the local *food industry* thinks that for them, landscape, pollination, natural forage and fodder, soil erosion control or wild plants are not important, when in fact these are indispensable for the production of raw material for the food industry. This ambiguity can also be explained by the fact that the few existing local food industry companies do not use local raw materials, but use raw materials from import or other intensive production. Also, farmers and wild plant collectors of the Niraj - Târnava Mică region either sell their produce abroad, or market their fruit, mushrooms, or wild plants that they collect from nature or produce locally using extensive farming elsewhere, at rather depressed prices. The rich natural environment and the extensive, near-natural technologies could be serious value-adding factors on the market (Turner et al. 2011), however, due to a lack of appropriate organizations, trade marks and underlying cooperation, this is not achieved. What makes the situation even more paradoxical is that **it is the local people who sustain this landscape with great diversity and naturalness**, however, they neither have access to its products, nor can they earn economic profit from it.

Companies involved in *tourism* attributed only little importance to natural assets (biodiversity, wild plants), however, they did mention that the diversity of the landscape was touristically important. This dualism probably stems from the fact that economic stakeholders think in terms of landscape scale but do not yet regard the elements of biodiversity as factors attracting tourists. In fact, in a region like this, poor in touristic programs but rich in species, natural assets smaller than landscape scale should be put to good use. All it would take is to simply recognize and understand “nature’s free goods” and to develop touristic programs that attract visitors in the long term.

In our assessment of the companies, we also tried to find out whether they were consciously mindful of the ecosystem services that they consider important for their success. With the exception of one company leader all representatives of the companies made reference to mandatory external regulations and said they made some efforts to preserve the given service only by observing them. Only the representative of a single company (tile stove maker) reported on responsibility for “internal motivation” pointing beyond observing mandatory regulations, who tries his best to ensure soil erosion control during his work even without external regulations. These results reveal the fact that

the majority of economic stakeholders have not yet recognized the need to make an effort to preserve the ecosystem services they use, as doing so would have economic consequences as well. Those local companies that have a long-term vision have a vested interest in preserving ecosystem service capacity facilitating the success of their own businesses. Naturally, knowing which of the regulations pertaining to them actually protect ecosystem services is already an important step.

Actors should protect at least those services that serve their interests, as through their use, these actors have the greatest impact on the services' quality. In this field, involvement of and guidance by larger companies would be essential as smaller ones usually do not have the financial means to do so. It is also true, though, that there are some things that would not require money and could be done through simple awareness and consciousness. Our survey shows that companies lack even the knowledge necessary to achieve this.

The reasons for the laws pertaining to each sector are, in many cases, not understood by company leaders or not even by decision makers at different levels, which decreases the likelihood of observing these laws.. In order to better observe these laws, legislators should not only introduce mechanisms for control but should also adequately inform the sectors about the reasons for the regulations for environmental protection. Economic actors need to understand that preserving ecosystem services is not merely an idea of legislators but the companies' own economic interest, too. Therefore, it is not just for controlling the implementation of laws to which human and financial resources need to be secured, but even more for educating and involving stakeholders at different levels.

### 11.1.3 How the future is seen (and desired) by the local communities - Conclusions derived from the scenario building process

In the second stage of the workshop, participants evaluated the scenarios in terms of the well-being of the key stakeholder groups. According to the well-being dimensions above, the vast majority of key stakeholder groups were assigned to a zero or positive range in the "B"- GreenTech scenario. This indicates that irrespective of whether a specific stakeholder is viewed as positive or negative by the community, this scenario is regarded as favorable for the majority. In scenarios "A" – As helpful as kissing frogs and "D" – Opportunity in unity, approximately twice as many stakeholder groups were assigned to the positive range as to the negative one. The well-being of stakeholders is the least favorable in scenario "C" – Take it and rule, where almost the same number of stakeholder groups were included in the negative and positive range.

As a conclusion to the workshop, participants selected the scenario they deemed most desirable considering the advantages and shortcomings of each scenario. The choice between scenario "B" – GreenTech and "D" – Opportunity in unity proved difficult during the discussions. A strong, cohesive community plays a vital role in both scenarios. However, while in scenario "B" it is accompanied by a green, environmentally friendly regulatory system that makes it almost utopist, scenario "D" is characterized by gray, non-environmentally friendly regulation that, albeit being less favorable, seems more realistic. Based on the final decision of the participants, scenario "B" – GreenTech was selected.

For assessing the probable future development of the various ESs, we averaged the mean values for each scenario of the respective service (resulting from the scenario quantification process, see *Chapter 10.3.1*), arriving at an ordinal scale value (from strong/ slight increase, constant to slight/strong

decline). Uncertainty of this future development of the capacity of different services was assessed based on the uncertainties given during the scenario quantification for each of them, originating from uncertainties associated with the area changes of the habitat map categories (resulting from land use changes).

## 11.2 Integrated valuation of the most important ecosystem services in the area

The importance of ecosystem services can be derived from an array of aspects. Ecosystem services improve people's individual and social well-being in many ways. A healthy environment contributes to preserving the physical and mental health of local people. The local population has an attachment to the land that provides them with roots, identity and common values cohering the community. Well-functioning ecosystems are more resilient to external forces (e.g. climate change) and can better mitigate environmental risks. A significant share of services improves the local economy and livelihoods of locals also directly in the form of market goods and added value.

The process presented in the previous chapters reflects several of these aspects. There are three main approaches that have evolved in the international practice of ecosystem service valuation: biophysical valuation, economic valuation and social (socio-cultural) valuation. The total value of services cannot be expressed in monetary terms in a simple and direct way. Health, security and community cohesion for instance are values that are critical for the future of the local community in an ever-changing world full of challenges, and money is not an appropriate unit of measurement to express their value. In order to obtain a complete overview of the path of ecosystem services from nature to society (see **Fig. 7.1**) and all important societal benefits of these services (e.g. health, security and material well-being), we need to use all three approaches simultaneously ("in an integrated way").

In the following table (**Table 11.1**) we present all these different ways of valuation next to each other in order to make an integrated way of assessing ESs possible, while in the following sections (in *Chapter 11.2*) we analyse the underlying patterns, reasons and forces in relation to the local communities as well as to regional (and national) legislation.

The bio-physical valuation of ESs in the present project started off from a habitat map (**Fig. 7.2**), which shows the landscape divided into functional units relevant from the aspect of ecosystem services. For this reason we represented on the map different natural habitat and land use types. The mapping of the majority of services constitutes a biophysical valuation combined with participatory elements (detailed in *Chapter 7*), while economic valuation provides a more informative picture regarding the "income" generated for the region by the functioning of ecosystems (detailed in *Chapter 8*). Adding socio-cultural valuation from the point of view of local people (*Chapter 6*) and of local economic actors (*Chapter 9*) is essential for assessing the importance of ESs in an integrated way. Deriving conclusions from the future scenarios developed (*Chapter 10*) helped to complete the picture with the expected future importance of the different services. The different elements of valuation can also be placed along the ES cascade (see **Fig. 7.1**): The starting point was mapping of ecosystem condition indicators (level 1), which serve as fundament and enable ecosystems to provide services (capacity, level 2). The actual use of services (in biophysical units) and benefits (in terms of monetary benefits as well as other, non-monetary additions to human well-being) can be placed on the cascade levels 3 and 4, respectively.

**Table 11.1:** Key results of the social and economic valuation of ecosystem services.

| | Economic value (million RON/yr) [EUR/yr] | | | Importance perceived by the population (%)[1] and the most common reasons | | Importance perceived by economic stakeholders (%)[2] and sectors most affected[3] | | Expected future changes in the services[4] | |
|---|---|---|---|---|---|---|---|---|---|
| | capa-city[5] | actual use[6] | methodology | | | | | trend | uncer-tainty |
| Wood and timber | 20.1 | 14.8 | capacity: based on average annual increase during the economic life cycle of forests, without discounting<br>actual use: based on logging data | 45% | raw materials, livelihood, building materials, oxygen production, clean air | 52% | logging, wood processing, plant production, livestock farming | slight increase | small |
| Natural forage and fodder | -- | 14.1 | based on market off-take of grazing sheep and cattle populations | 28% | livestock production, livelihood | 28% | livestock farming, plant production | slight increase | small |
| Wild plants and mushrooms | -- | 1.7 | average quantities calculated based on the number of collection permits issued, multiplied by average buying-in prices per species | 44% | health, medicine, food, livelihood, recreation | 32% | (there were none among sectors consulted) | strong decline | large |
| Honey and pollination | | | | | | | | | |
| Honey and nectar | 4.5 | 3.8 | capacity: based on the estimated annual quantity of honey that can be collected on average in different habitats of the area<br>actual use: number and average production of registered bee colonies | 41% | pollination, health, food, healing properties, livelihood, experience | 26% | livestock farming (beekeeping) | con-stant | medium |
| Pollination | -- | | | | | 40% | livestock farming, plant production | | |
| Water retention | | | | | | | | | |
| Water regulation | -- | | | 72% | basic needs, water quality, health, wildlife, food, livelihood (fishing), recreation | 72% | all sectors | slight decline | large |
| Erosion control | -- | | | 25% | landslides, soil erosion control, basis for food production | 38% | livestock farming | | |
| Carbon sequestration (climate protection) | 5.7 | 5.7 | drawing on the methodology of the Romanian national greenhouse gas inventory, based on emission-trading market prices[7] | 40% | climate change as a global problem | 46% | livestock farming, plant production | slight increase[8] | small[8] |
| Touristic attractiveness and local identity | | | | | | | | | |

| | | Economic value (million RON/yr) [EUR/yr] | | | Importance perceived by the population (%)[1] and the most common reasons | | Importance perceived by economic stakeholders (%)[2] and sectors most affected[3] | | Expected future changes in the services[4] | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | capa-city[5] | actual use[6] | methodology | | | | | trend | uncer-tainty |
| | Tourism | -- | 16.9 | based on the number of visitors in the area and the amount of money spent by them for touristic or recreational purposes | 49% | livelihood, potential for development, acquiring knowledge, experience, beauty, clean environment, valuable natural environment | 48% | food retail, catering, tourism, livestock farming, plant production | con-stant | small |
| | Local identity | -- | | | 48% | respect for traditions, emotional bond, national self-awareness | 62% | food retail, catering, tourism, plant production | -- | -- |

[1]: based on results of the questionnaire survey carried out among the local population (see *Chapter 6*) (what percentage of respondents ranked the specific service among the 5 most important)

[2]: based on the questionnaire survey carried out among economic stakeholders (score assigned by businesses as a percentage of the maximum score)

[3]: sectors that assigned a score of above 50%

[4]: based on the results of the scenario planning process: the average trends of expected changes in the four possible scenarios (*Chapter 10*)

[5]: esimated economic value of ecosystem service capacities per year (**Fig. 7.1**, level 2: service that can be exploited sustainably under current land use ratios)

[6]: estimated economic value of current actual use (**Fig. 7.1**, level 3) in the year 2015

[7]: carbon sequestration, similarly to other regulating services, is "used" without conscious human involvement, too, which is why actual use can be considered equivalent to capacity

[8]: carbon sequestration, a service difficult to interpret at the local level, was not included in the scenario planning process, but the results obtained for the "wood and timber" service in terms of trends and uncertainty can be considered valid for this service, too

### 11.2.1 Ecosystem condition indicators: habitat naturalness, landscape diversity and soil fertility

Ecosystem condition indicators are chosen to represent the general state of the inspected ecosystem, on which the actually targeted services rely on. It is an intrinsic feature to ecosystem conditions vs. ecosystem services (and regulating services vs. provisioning services), that the latter are generally higher valued by the public, as they are more tangible.

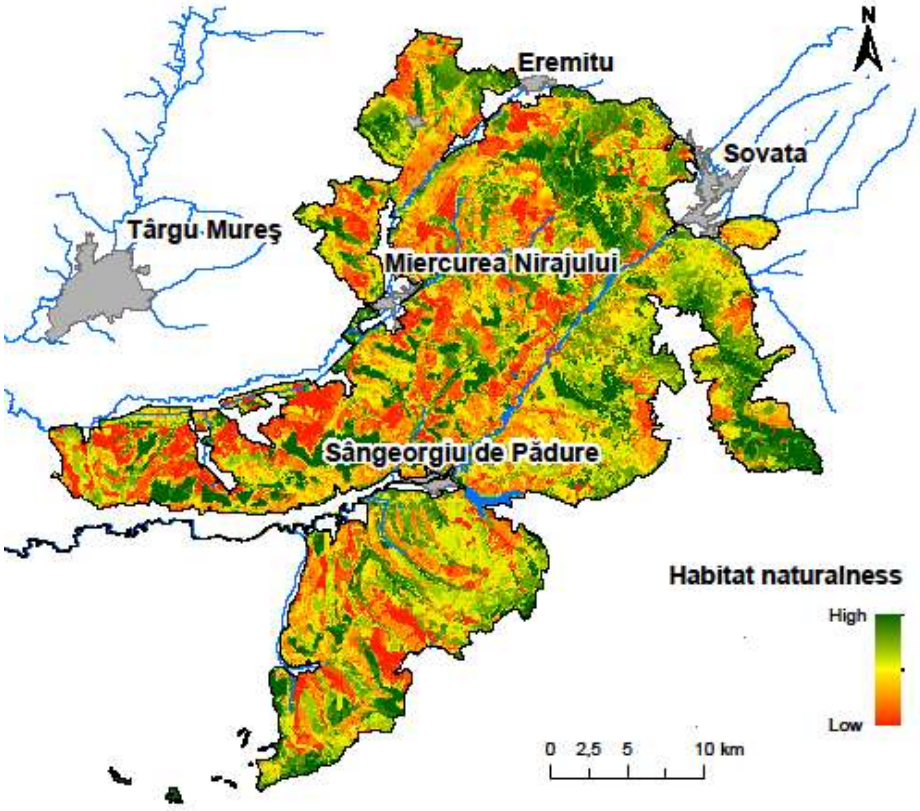


**Fig. 11.1:** Naturalness of habitats: the capacity of habitats to maintain biological diversity estimated using statistical models based on bird distribution data, satellite images and other environmental variables.

We considered the natural or altered state, diversity, and wealth of ecosystems using two **ecosystem condition indicators** on two different spatial scales. We characterized fine-scale biodiversity of wildlife using a **naturalness** index based on bird occurrence data while a **landscape diversity** index was used to describe diversity of habitats representing broader changes in the landscape (**Fig. 11.1** and **Fig. 11.2**). The Niraj - Târnava Mică can be regarded as an area of outstanding diversity from both aspects on a European as well as on a Romanian level.

A landscape's naturalness is primarily determined by its biodiversity and the landscape structure (landscape diversity) affecting it.The basis for the high biodiversity of the region is provided by **deciduous forests, pastures, small-scale agricultural areas, as well as meadows and encroached grasslands**.It is worth pointing out among these, the importance of small-scale, mosaic agricultural areas, which, due to their naturalness and landscape diversity, greatly contribute to the region's biodiversity. This is a fine example of the balance between human activity and nature, which seems to be dangerously deteriorating.

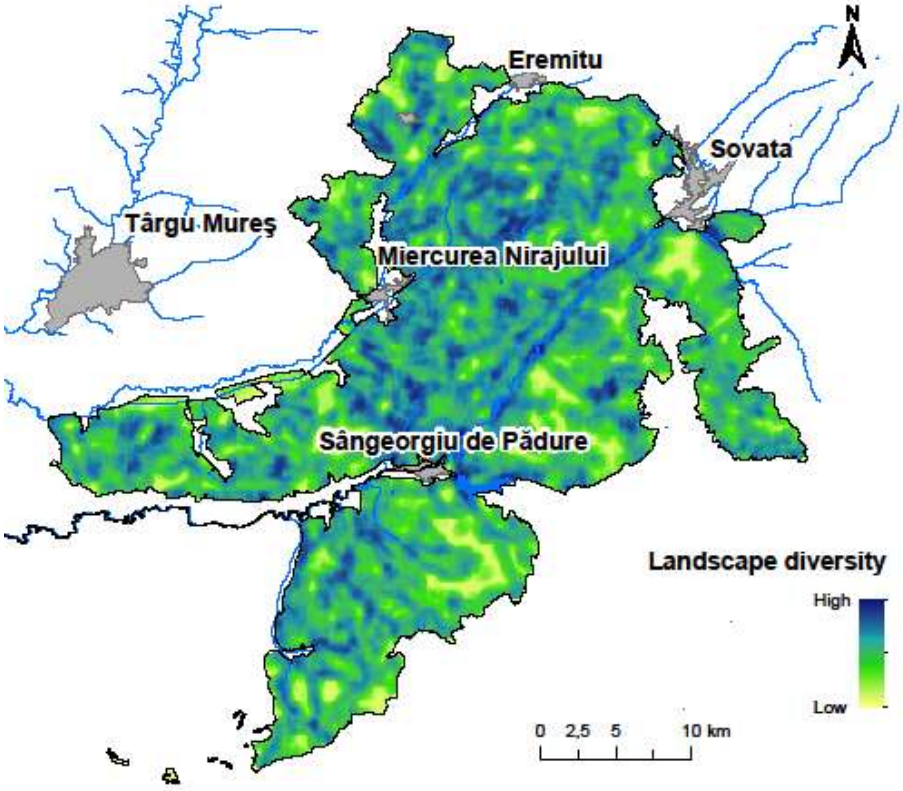


**Fig. 11.2:** Landscape-level habitat diversity expressed with a mathematical formula (Shannon diversity index of the main habitat groups at a rough (~1 km) scale).

Habitat naturalness and landscape diversity are ecosystem condition indicators which are not directly utilized but contribute to providing many different ecosystem services indirectly. The "value" of these condition dimensions manifests itself only indirectly in the economy, too. However, naturalness **was ranked very high** by local economic actors. The interviews conducted at the beginning of our research also revealed that, although local people have a strong attachment to their natural environment, they are less aware of what the activities and impacts are that can lead to the deterioration of the region's naturalness.

The basis for maintaining naturalness is preserving **landscape structure**. It is necessary to avoid land use change or fragmentation of the landscape (breaking its integrity with roads or other elements impassable for living beings). Landscape structure secures the high biodiversity of this region, enabling ecosystem services to contribute so greatly to the well-being of local people. In today's rapidly-changing world the preservation of habitats and landscape structure is perhaps one of the greatest challenges. This is most likely going to work when community solidarity becomes strong in the region - according to local people's most preferred scenario.

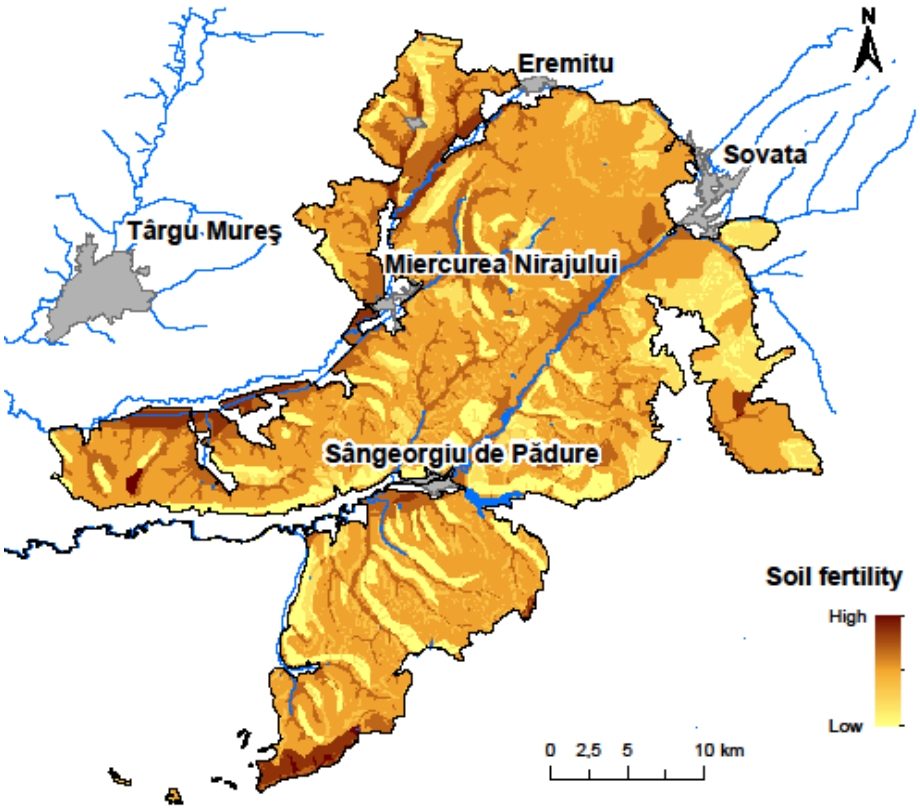


**Fig. 11.3:** Estimated soil fertility (capacity to be used for arable land and stoop crops) on an expert preference scale.

One of the key agricultural sectors of the Niraj - Târnava Mică region is arable farming and horticultural crop production. Since in today's production practices nature's contributions are dwindling small compared to human inputs (fertilizers, machines, fuel, chemicals), crops themselves cannot be regarded as ecosystem services. However, it is important that they should be present when taking stock. In our research, nature's contribution to agricultural production is mainly reflected through **soil fertility** as an ecosystem condition indicator.

The region's soils possess medium quality fertility - there are no soils with nationally outstanding fertility in this region of the country (**Fig. 11.3**). Areas with higher than average fertility are found only in riverside fields. These once riverine floodplains have lost the natural supply of their fertility due to today's river regulation practice. One-sided water management practice only concentrates on the earliest drainage of the increased amount of water. This, however, not only diminshes soil fertility but also adversely affects the region's water management.

The larger arable lands were formed on the best soils of the region, however, erosion control and water retention in these areas are particularly poor. In order to counteract this, attention must be paid to the proper agricultural practices (e.g. plant cover and planting or preserving elements of green infrastructure). One-third of encroached grasslands are located on soils with very poor fertility. If bushes are cleared here to obtain subsidies, this might lead to further erosion and further loss of fertility for these soils, if the land is ploughed up or heavily grazed. If this happens, soils will become even poorer and their capacity to provide ES to the local communities will further decrease.

Soil fertility was ranked among the key ecosystem services by half the population: it is the sixth most important ecosystem service for local people. With a view to the future, it is especially important that it was ranked high by young people, too.

**Companies** also, indicated high dependency: soil fertility was ranked the third most important service by them. It was found particularly valuable by companies involved in agriculture, beekeeping, logging and wood processing as well as the food industry. In contrast with other services, this condition indicator was ranked high even by companies not directly dependent on soil fertility (e.g. wood processing and the food industry). Soil fertility is a well-acknowledged service in a rural society, in comparison to some other services (e.g. soil erosion control) which do not receive attention due to a lack of information and consciousness. There are established agricultural techniquesfor the preservation of soil fertility but in many cases local farmers lack the knowledge to utilize these ("I spread manure the same way as my neighbor"). Due to the excessive use of fertilizers in the communist era, which is partly still practiced today, the region's water supply is infused with nitrates. For a future sustainable life in the region agricultural practices need to be adopted which do not damage other natural assets.

## 11.2.2 Wood and timber

The major share of wood production is secured by the natural **deciduous forests** covering one-third of the area (**Fig. 11.4**). The wood producing potential of these forests represents medium quantity but the wood and timber produced on them (oak, beech, etc.) are considered particularly valuable. Planted pine and robinia forests have a greater specific contribution to the area's wood-producing capacity (expressed in wood volume), however, due to their small size, they are less important.

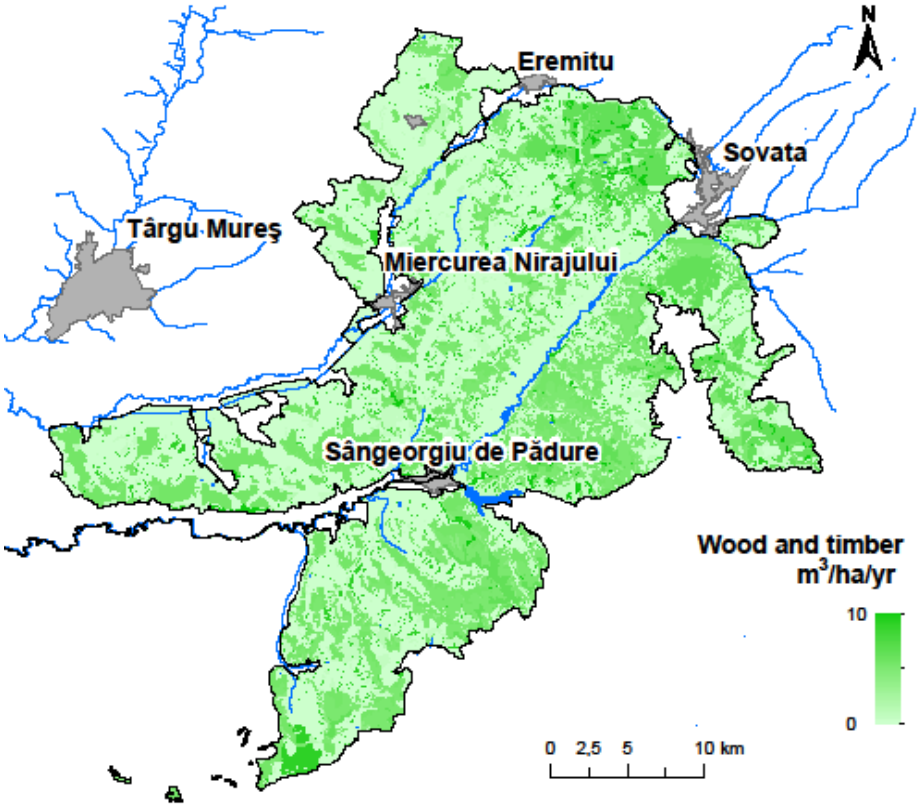


**Fig. 11.4:** The landscape's long-term capacity to provide wood and timber.

In contrast, the wood-producing potential of the tree rows and narrow galleries consisting primarily of riverine willow and alder groves is exceptionally high but while their role is important for conservation and climate regulation, the value of their timber is low.

The annual **capacity** of forests under forest management in the study area is about **20 million RON (4.4 million EUR).** Roughly **74%** of this capacity currently appears in the official economy.

We must not interpret this result as underuse for the following reasons:

- In case of heavily regulated services like wood and timber there are established methods for capacity estimation from which we cannot divert. However, these methods were developed to take, of all the potential ecosystem services of forests, only wood and timber into account while neglecting other services. The use around 75% brings us very close to exploiting maximum capacity, which if realized, would damage the region's multifunctionality, reducing the ecological condition and the other ecosystem services .
- According to official data, illegal cutting of trees accounts for 50% to add to legal production nationwide (INS 2016, Greenpeace 2015). This means that in the region the actually produced quantity may exceed annual production. In addition, illegal logging does not take into consideration norms that even otherwise profit-oriented forestries observe. Instead, they carry out the logging driven by their greatest momentary profit (Ioan & Rădulescu 2015).
- As a combined result of legal and illegal logging, the extent of forest use is already approaching (or exceeding) maximum capacity. This impairs the ecological condition of forests which entails loss of wood and timber yield as well as of other services (water retention, carbon sequestration, etc.) provided by forests, (which may have serious economic consequences).

Thus in the case of forests capacity, reserves are only **illusory**. If we want to harvest wood in a sustainable manner and thereby also keep other ESs and the proper ecosystem condition, we need to be more serious about enforcing and keeping forestry laws.

Twenty-two percent of the forests in the Natura 2000 areas of the Niraj - Târnava Mică region are **not under forest management.** This is due to the fact that the types of tenure and property deeds of a portion of forests returned to smallholder farmers after the change in the economic and political regime is still unsettled. On the other hand, in some cases the owners did not place forests on settled lands under forest management, either. There are also wooded areas that are currently registered as some other land use type than forests, but which are spontaneously afforested with at least 40% cover (1122 ha). Such areas should be incorporated in the managed forest areas in order to have better control over their usage (i.e. upgraded to a forest by law when their area reaches 0.25 hectares). The relevant local governments fail to do this sometimes out of neglect, but also due to the fact that they can freely issue felling permits (without any external control).

As the primary focus of the forestry sector is on the most efficient way of wood harvest, companies involved in the forestry sector are not receiving any subsidies to preserve any other potentials (or ecosystem services) in the managed forests. Schemes need to be developed and implemented, that reward companies to maintain various kinds of ecosystem potentials within their forests (Ioan & Rădulescu 2015)

Although the present forest management norms cannot be considered integrated, either, the ecological condition of the region's forests are mostly threatened by illegal felling. This nationwide problem has been recognized even by the government who is trying to introduce measures to tackle the problem. However, in many cases these measures affect the local population adversely, making it

difficult for them to obtain wood and timber for their own use. Any measures can only be efficient with the active cooperation of the population, therefore, forestry laws have to integrate local communities' interests in order to be successful (Mikulcak et al. 2013). Community cohesion, a major feature of the local people's coveted scenario is also necessary for protecting forests.

Half of the population consider wood and timber in the area of the project very important, and also half of the companies show some degree of dependence on this raw material. Naturally, logging companies' dependence is particularly great on this ecosystem service. Wood represents the basis for local well-being. This could contribute to the local economy in a greater proportion than at present if the local population and local businesses were to be the first recipients of logging and the raw material (i.e., they would be the ones to use or process them) rather than extra benefits being made primarily by external actors (ECE/FAO 2001).

According to the outlined scenarios, the region's wood and timber producing **capacity will slightly increase**, largely due to stricter forest management regulations and afforestation of abandoned encroached grasslands. If local people and communities began to think in integration and sustainability terms about the use of forests, the expected increase in wood and timber, together with other services of the forests, could contribute to the region's well-being on a much larger scale.

### 11.2.3 Natural forage and fodder

Obviously, **pastures** and **meadows** were ranked highest for this service. Also high rankings were given to wood pastures, encroached grasslands, and tree rows and galleries (due to the herbaceous vegetation accompanying them) also has good capacity. As a whole, the area's capacity and its utilization show a very heterogenous distribution (**Fig. 11.5**). There are places where overuse has already appeared, mostly in the form of **overgrazing** while some other places are characterized by **abandonment** or undergrazing, which also leads to the deterioration of the quality of grasslands.

Three quarters of pastures and meadows are of medium or very good capacity. One quarter, however, is very poor for various reasons. A grassland's capacity to provide natural forage is greatly affected not only by various physical factors (slope, soil acidity, altitude above sea level) but also by its naturalness and its previous grazing intensity. To prevent these poorer capacity areas from significantly degrading, it is necessary to consider pastures' rather diverse abilities to provide this service when determining optimal grazing pressure. To be able to do this, users need to possess knowledge and awareness. In the region this is present either as traditional knowledge or expertise, but in some places this knowledge might be lacking (e.g. in farmers out of necessity) or disregarded for the sake of momentary profit making., degradation of grasslands may increase. In addition to determining ideal grazing intensity, it is also very important not to allow its naturalness to worsen. It is not possible to preserve the naturalness of individual patches of grasslands; this can only be done on a regional level, as a network of grasslands, which can be achieved through the conscious activities of local communities and leaders.Considering nationwide tendencies and Transylvania's similar but more intensively cultivated areas (Urushibara-Yoshino et al. 2006), further increase in overgrazing can be expected in this region, and we need to prepare for it as soon as possible.

The present Romanian law on grasslands (Institutul de Cercetare - Dezvoltare pentru pajisti 2014) is rather strict and thorough, but expertise is lacking in many places to implement complicated requirements. It is the local governments' responsibility to prepare the grazing plan for all the grasslands of the settlements, for which they do not have the appropriate experts.

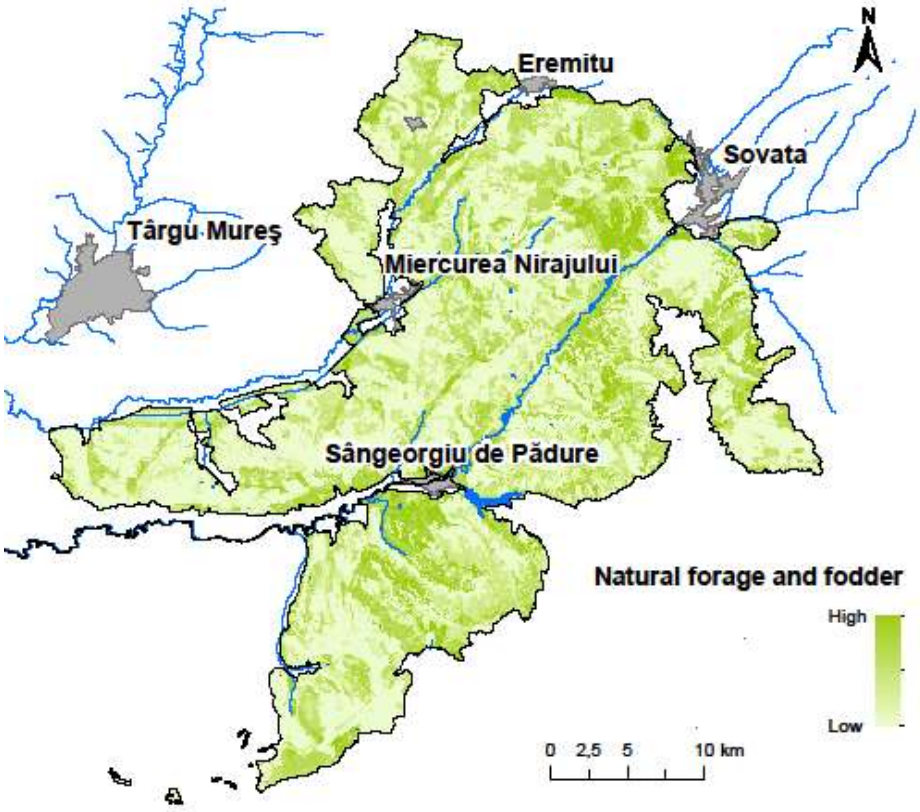


**Fig. 11.5:** The landscape's capacity to provide natural forage and fodder for domestic animals.

Only one-third of the population said that they found natural forage and fodder important despite the fact that the region's livelihood is heavily dependent on agriculture. Similarly, only companies involved in livestock breeding reported dependence. Grasslands' capacity to provide forage and fodder (as grazing or hay) at present contributes **14 million RON (3.1 million EUR)** to the economy of the Natura 2000 areas of the Niraj - Târnava Mică region. If we consider the fact that grasslands provide numerous other services in addition to forage and fodder (e.g. herbs, mushrooms, touristic attractiveness, soil erosion control, and water retention), we can see that their role in the local economy is even greater. The area's capacity is much greater than this since encroached grasslands, which account for 7.6% of the area and were formed as a result of abandonment, also represent some kind of reserve as forage and fodder. According to the scenario outlined by local stakeholders the region's capacity to provide natural forage and fodder will slightly decrease primarily due to loss of habitat. If we want to make sure that this decrease affects local economies and farmers as little as possible, the quality of grasslands must be preserved. To avoid the issue of intensification and overgrazing, legislature is needed in addition to the awareness of local decision makers and communities to integrate the ability of grasslands to provide diverse ecosystem services.

### 11.2.4 Wild plants and mushrooms

The area as a whole has a large capacity in terms of gathering potential (**Fig. 11.6**). The diverse grassland types are of particularly large capacity (wood pastures, pastures, meadows, encroached grasslands), but deciduous forests, groups of trees, extensive orchards and even small-scale agricultural areas also greatly contribute to the region's capacity to provide an official source of 130-300 tons of mushrooms, herbs and plants per year.

Wood pastures have the highest capacity, but due to the smaller size of the area they occupy as a whole, they contribute to the landscape with their edible goods to the same extent as other types of grassland.

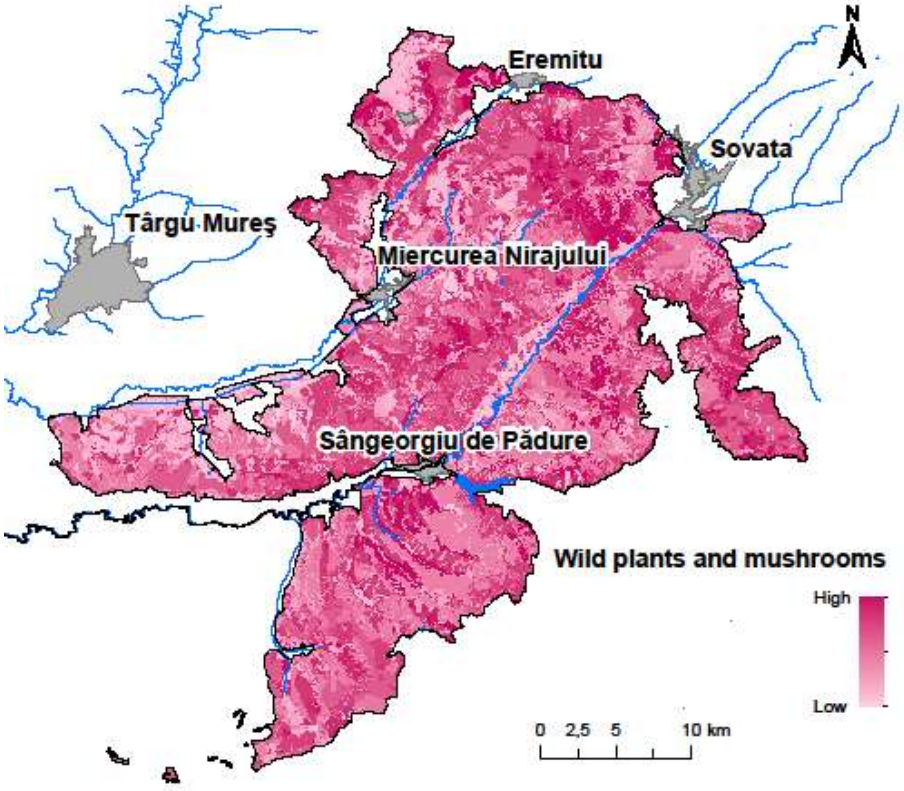


**Fig. 11.6:** The landscape's capacity to provide wild edible mushrooms, berries and medicinal herbs

Close to half of the population consider these gifts that can be picked from nature important, and rank them among the key services. People in many places use these as part of a healthy way of life, or for nutritional reasons while others regard picking these goods in nature as a recreational activity.

One-third of the companies feel dependent on these goods albeit slightly. However, among the companies interviewed there was not a single company involved in the processing or official harvesting of these goods. The economic value of the officially harvested quantity of these goods is almost **2 million RON (400 thousand EUR) annually**. This is not a service of outstanding economic value; however, its societal function is very significant. This contradiction is also revealed if we compare the ES wood and timber with that of wild plants and mushrooms: while both were considered as equally important by local people (45 and 44%, for wood and wild plants & mushrooms, respectively) , the estimated economic value of wood is ten times higher than that of the latter. Similar discrepancies between economic importance and socio-cultural importance can be found throughout Europe (Schulp et al. 2014).

Mostly private individuals perform the harvesting using the issued permits and then pass the picked goods on to resellers outside the sample area. This way only few of these natural goods remain in the area. Picking goods from nature as a touristic attraction programme is at present an unrealized potential of the region. If this activity were sustainably integrated into the local economy, it could significantly increase the well-being of locals and visitors.

Gathering on a large scale is mostly performed by people living in extreme poverty or on the margins of society, who have little or no chance of finding employment in other fields of life - similarly to the social patterns found elsewhere in Central Europe (Rodina 2014). In certain villages larger groups of people have lived off this activity for generations. The traditional ecological knowledge these people have of the various herbs, edible berries or mushrooms and their places and times of collection is such that can be regarded as valuable in itself (Ju et al. 2013, Pardo-de-Santayana et al. 2007).

In spite of this, these groups of people are generally in conflict with the authorities or responsible forestries. This is primarily explained by the fact that intensive foraging causes damage to the primary products in the area (e.g. wood or grass fodder). It would be important to establish a legal framework and practice that would create coordination between owners of areas and the people intending to gather wild plants there, as has been attempted also elsewhere in Europe (WWF 2013). This would facilitate preservation of individual traditional knowledge and prevent the situation where society has to support this marginalized group, who contribute to providing us with healthy foods collected from nature.

### 11.2.5 Honey and pollination

The Niraj - Târnava Mică region does not belong to the most outstanding bee pastures in Romania. In spite of this, there are a number of villages in the area with remarkable apiculture and expertise. Beekeeping plays a relatively important role in the local economy as well. Nevertheless, its economic importance is far lower than its socio-cultural importance to locals, similarly to what we experienced with wild plants (economic value of honey is only a quarter of that of wood while its importance for the local people is 41% compared with 45% for wood)). The area's potential honey-producing capacity is shown in **Fig. 11.7**. According to these calculations, the area's honey-producing **capacity amounts to 4.5 million RON (1 million EUR) annually**, 86% of which is currently realized in the economy. (The value that local beekeepers produce from the honey collected during migration is significantly larger than this, however we deliberately excluded this non-local value from our calculations.)

The honey from the nectar collected in bee pastures is closely linked to another, regulatory service: pollination of crops. Like soil fertility, this service can also be regarded as a basic (regulating) service provided by natural ecosystems that secure the success of agricultural cultivation (IPBES 2016, Klatt et al. 2013, Mburu et al. 2006). Its monetary value is very difficult to express but, according to international calculations (Levin 1983, Mburu et al. 2006) it greatly exceeds the monetary value of the collected honey. Bee pastures with an appropriate area, nectar abundance and biodiversity sustain honeybees and beekeepers in addition to their own remarkable wild bee fauna, which also contribute to the productivity of neighboring agricultural habitats. Decrease in the number of natural pollinating insects is a worldwide tendency which threatens the successful pollination of many crop and even natural plant species (Allsopp et al. 2008, Kovács-Hostyánszki et al. 2017, Mburu et al. 2006).

It is to be expected, then, that the role and value of this service will rise in the future.

As the value of an area is determined by the same feature (floral abundance) of the area for honeybees and wild bees, the estimate and map that we have prepared to represent the capacity of the nectar- and honey-providing service can simultaneously be regarded as a good capacity estimate for pollination as an ecosystem service. Providing honey and nectar is thus a service of outstanding importance, not being limited to provisioning, but also featuring regulation. It is not only necessary to preserve its capacity but it is also worth considering increasing it.

The region's nectar-producing capacity can be increased in cooperation with the farmer population only. To achieve this, an integrated plan for the cultivation of meadows and ploughlands needs to be developed that would combine the benefits derived from the various ecosystem services. Organic production, for example, creates safe conditions not only for bees but also for other pollinating insects. For the implementation it is indispensable to create awareness and cooperation in all actors involved in the various sectors (e.g. farmers, beekeepers) along with providing subsidies and forms of organization that minimize the likelihood of momentary financial disadvantage.

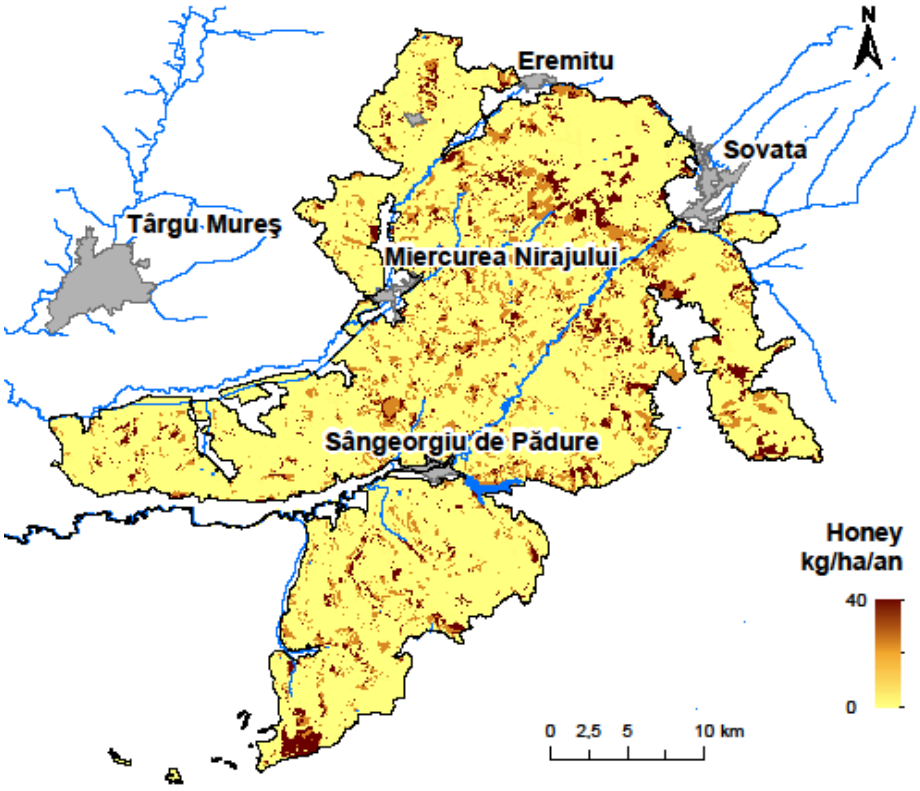


**Fig. 11.7:** The landscape's capacity to provide source of bee pasture and honey production

Securing pollination was ranked as important by close to half of the population.It shows a great degree of awareness that people did not only attribute great importance to the health and enjoyment value of diverse apicultural products, but also found bees' pollinating work important. A quarter of the economic actors found pollination important; of these beekeepers ranked it very high while actors in other sectors attributed little importance to it. In contrast with the population, companies involved in agriculture recognized their dependence on pollination to a lesser extent. It is generally true that we do not appreciate anything whose role we are not aware of. Awareness is of utmost importance for establishing a successful cooperation between farmers and beekeepers as well as for this service to continue to exist in the future.

### 11.2.6 Water retention and soil erosion control

The soil erosion control and water retention of the different habitats are determined by the same factors. Realized soil erosion mitigation and water retention depends primarily on the vegetation covering the soil, that is, on the given habitat but it is also greatly influenced by the area's slope, too (**Fig. 11.8**)(Gajic 2008, Le Bissonnais et al. 2002, Pimentel et al. 1995). **Forested habitat types** have the largest capacities but **encroached grasslands** are also very important. According to comparative

calculations, the capacity to mitigate soil erosion and regulate water retention of all vegetation types could amount to about **22-26 million RON/year (4.8 -5.7 million EUR/yr)** within the Niraj - Târnava Mică region.

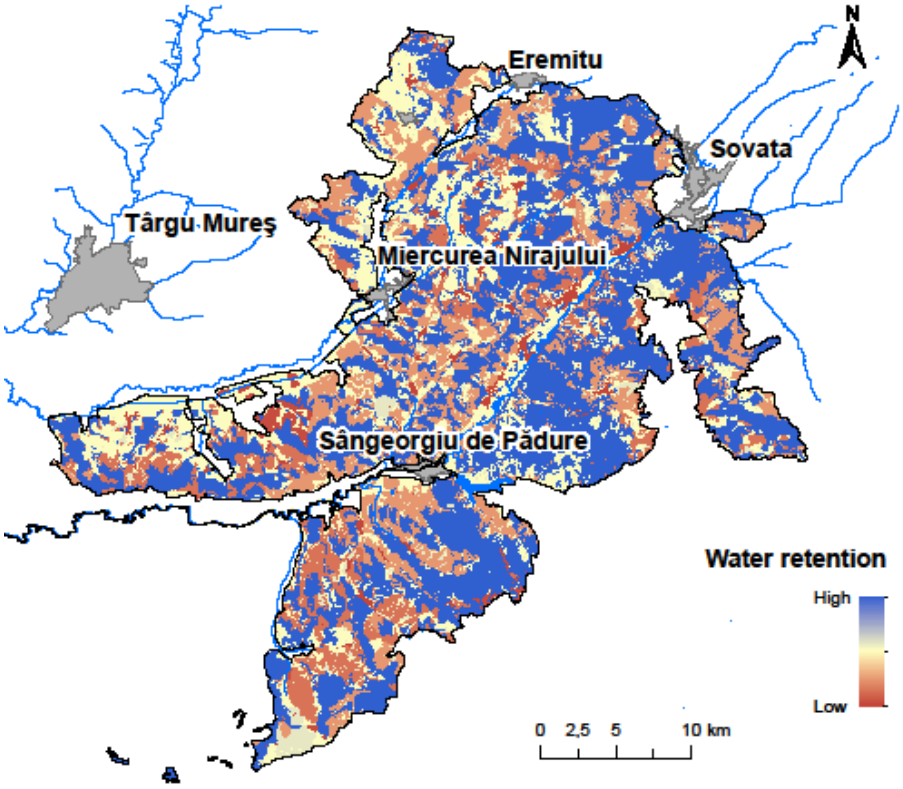


**Fig. 11.8:** Capacity of ecosystems to slow surface water runoff, and thus contribute to the recharge of regional groundwater resources and mitigate soil erosion

From the aspect of soil erosion, habitats that are bare (without vegetation cover), for a period of time are most vulnerable (Elliot et al. 1999, Gajic 2008, Le Bissonnais et al. 2002). These are typically ploughlands, or, in some cases, plots and gardens which belong to the village. Forestry management methods involving baring the soil also lead to significant erosion over a long time (Elliot et al. 1999). In the case of settlements soil sealing (development of built environment on agricultural or other rural land) involves increased water drainage even without erosion, which leads to water loss. On grasslands it is grazing, especially sheep grazing, that may increase the risk of erosion and decrease water retention as sheep grazing results in much shorter and more erodible grass than cattle grazing. However, the water retention of **meadows** as closed, untrodden grasslands, rival that of wooded habitats. Thus in addition to their other benefits, meadows also have a key importance through their water retention and soil erosion control function, which goes well beyond the borders of the particular habitats.

The population ranked **water** as the most important service. Three quarters of local people found the region's water retention important, whereas only a quarter of them had the same view of soil erosion control. The same ratio can be observed in the study of companies' dependence. Interestingly, companies that signalled strong dependence on soil fertility did not find soil erosion control important. These results point to a lack of information about the interrelationship between soil fertility, soil erosion control and water retention.

According to the scenarios outlined by local people, the region's capacity will decrease in this service due to some degree of assumed intensification in agriculture and infrastructure development in addition to global impacts.

In the fight against global climate change, in addition to emission reduction (mitigation), it is important to shape a region's land use in a way that dampens the impacts of increasingly extreme weather conditions caused by climate change (adaptation). A diversity of measures can contribute to the reduction of damages caused by droughts or extreme rainfall events (e.g. EC 2013a, EEA 2015, Jakab & Makkai 1999), for example by avoiding illegal felling, the tillage of grasslands, the drainage of wet meadows, and other bad agricultural practices (e.g. hill-valley direction ploughing) - to name a few of the most common problems in the Niraj - Târnava Mică region.

There is a great need for integrated decisions that consider cross-sectoral impacts from the various professional and political decision makers (Mikulcak et al. 2013). Land users and decision makers need to make concerted efforts to preserve and maintain the quality of habitats that are of high importance in terms of water retention and erosion control. Only this way can they provide these crucial protective and regulatory services for local people.

### 11.2.7 Climate regulation and carbon sequestration

Sequestration of carbon dioxide as the primary greenhouse gas involves storage of carbon in the biomass that is increasing (from year to year) in habitats. Thus the habitats covered by the quickest-growing perennial woody plants possess an **extremely high** capacity for carbon sequestration, which are **encroached grasslands** (IPCC 2006). Also significant is the capacity of deciduous forests, robinia plantations and orchards to capture $CO_2$. The other habitat types do not capture $CO_2$ in net terms if calculated with the simplest methods in the international guidelines (IPCC 2003) (**Fig. 11.92**).

Although **deciduous forests** have medium capacity per unit area, due to their size (they cover one-third of the project area), they contribute the most to the region's carbon sequestration, amounting to two-thirds of the total capacity. The other one-third is provided by encroached grasslands, although this habitat type only accounts for 7.6% of the area.

The economic value of the region's $CO_2$ capture is **5.7 million RON (1.3 million EUR)** per year. This capacity is utilized 100% since the growth of the biomass capturing carbon dioxide is realized 100%, thus capacity always equals actual use. Most of the time the economic value of $CO_2$ sequestration is not taken into consideration when planning land use or creating forestry regulations. By capturing $CO_2$ , forests contribute a further 50% economic value to their worth derived from providing wood and timber.

At present, as a rule applied informally by the APIA, a farmer can only receive any kind of farm subsidy if they do not have more than one are (100 $m^2$) of bushes per hectare on their pasture or meadow. In view of the fact that encroached grasslands have double the $CO_2$ capture capacity of forests, decision makers should consider increasing the portion of areas that can be left encroached when allocating subsidies for grasslands. (Even worse, due to a clumsy practice, many APIA inspectors impose sanction for even less than that.)

Encroached grasslands are not only important factors in the fight against climate change, in fact, they offer other ecosystem services, too: they also have larger capacities in water retention and soil erosion

control than completely cleared pastures. In terms of nectar yield, they are incomparably better than "simple" pastures.

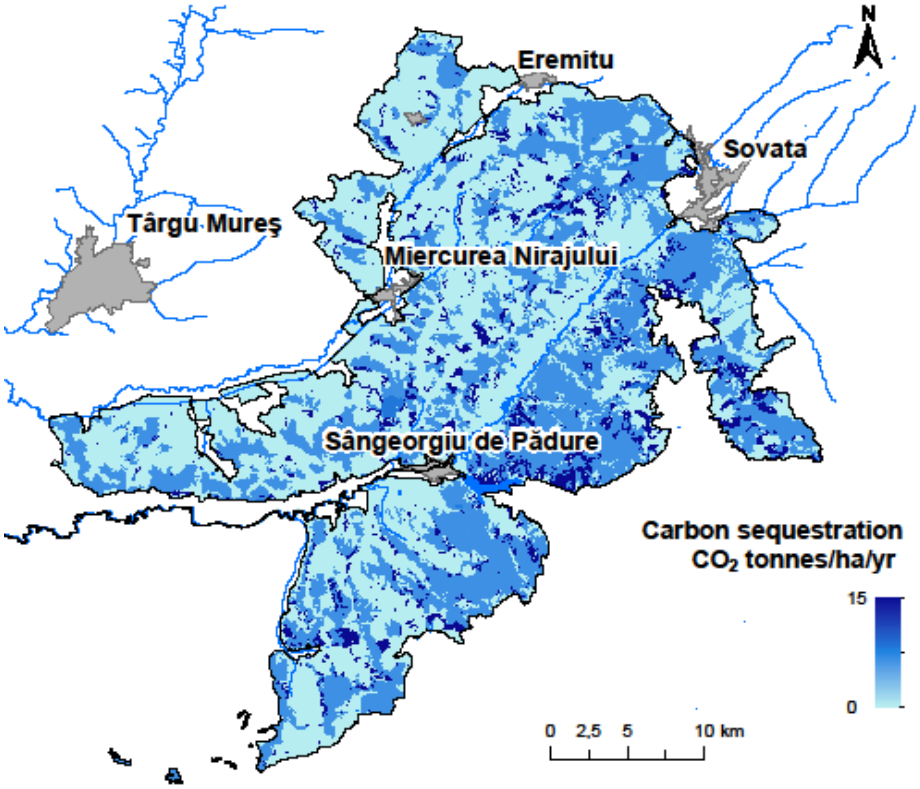


**Fig. 11.9:** The landscape's contribution to carbon sequestration and thus to global climate change mitigation

A smaller proportion of the population think that climate change mitigation is a very important service of the region, while the majority find it less important. Of the economic actors only beekeepers and those involved in crop production, i.e., those who are most directly affected by consequences of climate change, attributed greater importance to climate change mitigation. Other sectors attributed little importance to climate change mitigation despite the fact that companies living off livestock breeding, the food industry or tourism can be heavily affected by issues caused by climate change.

## 11.2.8 Touristic attractiveness and local identity

Close to half of the region's landscapes were ranked very high in terms of this service, offering important resting and recreational opportunities both for tourists and for local people, creating a base for emotional attachment. The highest scores were given to villages, deciduous forests, wetlands, wood pastures and small-scale agricultural areas. It is interesting to note that small-scale agricultural areas have greater capacity to attract tourists or create local identity than meadows or pastures (**Fig. 11.10**). However, it was the diversity of different landscape features/habitat types that was valued highest.

Half of the local population found the landscape's contribution to touristic attractiveness and local identity important. For a majority of respondents, probably those who are not involved in tourism, this service is primarily important for contributing to their own well-being by offering recreational opportunities. Many see the landscape as an asset in itself. Close to half of the companies attributed

some degree of importance to this service. Companies involved in catering, retailing and crop production found it more important and beekeepers thought it was more important than average.

At present tourism's annual contribution to the local economy amounts to **17 million RON (3.7 million EUR)**, but the region has a much greater potential as its tourism is not significant compared with other regions. The natural assets in this region need to be recognized by local people as valuable (Soran 2000 Mikulac et al. 2013). It is necessary to precisely assess what elements of the landscape should be highlighted in this region, what types of tourism programs can be developed that would make tourists not only interested in them but also encourage them to spend a longer period of time there without adversely affecting these assets (soft tourism).

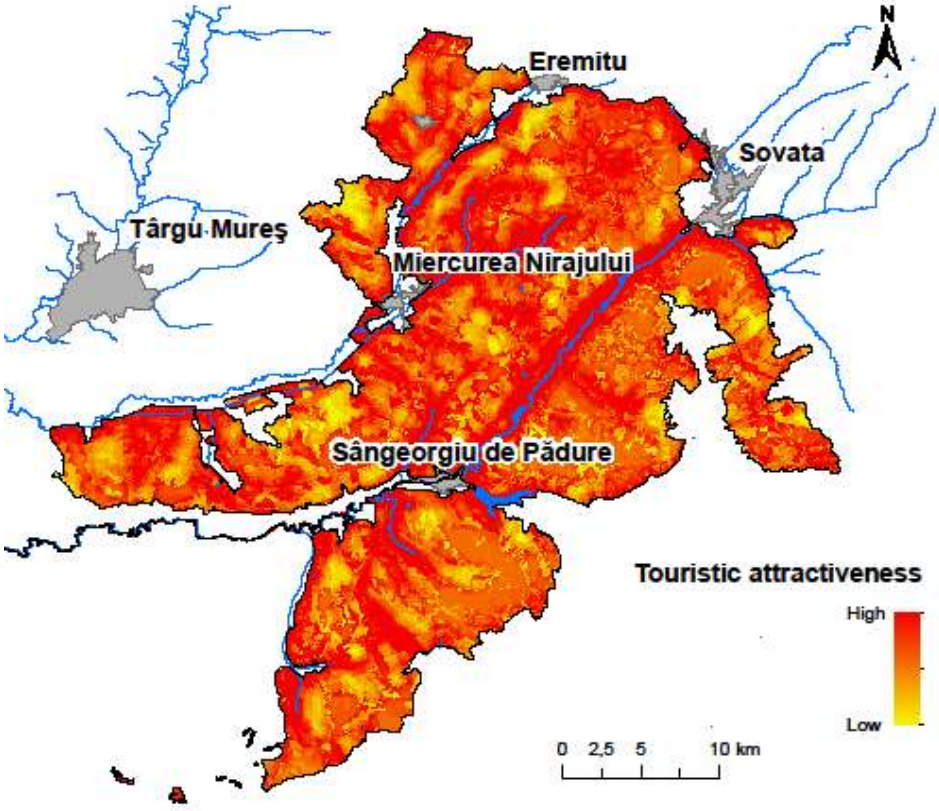


**Fig. 11.10:** The landscape's contributions to touristic attractiveness and sense of place

To be able to develop soft tourism in the region, we need to preserve the image of the traditional village and landscapes. Traditional landscape elements, as the trees of wood pastures are worth more as touristic attraction than as wood and timber. It is also recommended to design forest exploitation practices to preserve the forests' naturalness in the most frequented places and along potential hiking routes.

Boosting tourism would not require a great deal of financial investment; all it would take is to recognize and show natural and cultural attractions. Transylvania is one of Europe's most exotic regions – but the best way to show it still has to be found. After opening up to Europe, local people should also realize that things still common to them are being lost in Western Europe. If they fail to recognize this and to appreciate the value of their heritage, they will lose it. This is important not only because of the financial potential for tourism but also because this could function as a basis for the "cohesive force" keeping local communities together that is so critically important for the region's future, as testified by the conclusions of our scenario planning work.

## 11.2.9 An overview of all ecosystem services

There are several areas in the Niraj - Târnava Mică region that generate disproportionately high contributions to ecosystem service provision. To illustrate this, we have prepared maps that show, for every single point (pixel) of the study area, the number of services being provided at above average (the upper 50%, **Fig. 11.11**) or outstanding (the top 10%, **Fig. 11.12**) performance. Places that have above average or outstanding capacities for a number of services should be definitely preserved. Most of these areas are located on higher, varied terrains and consist of a mosaic of different natural and near-natural habitats.

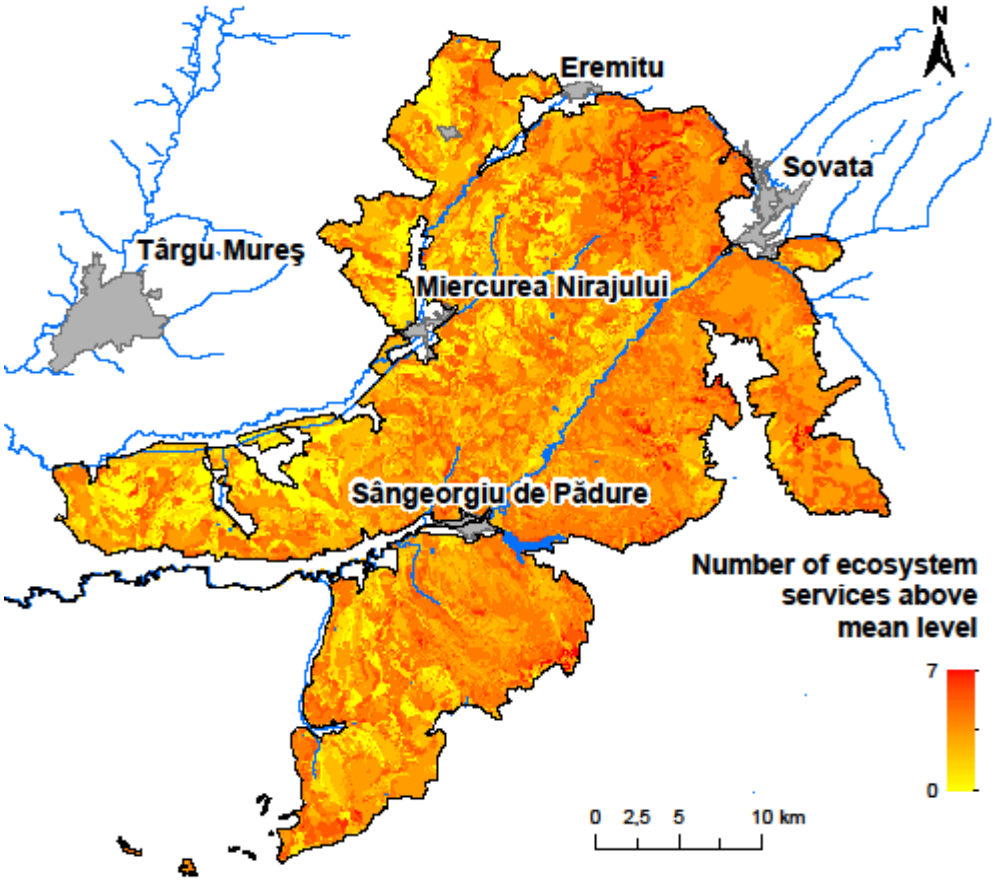


**Fig. 11.11:** Overview of ecosystem services in the Niraj - Târnava Mică region: the number of services provided at an above average level for each pixel

Except for the agricultural areas (the main crops of which we did not consider ecosystem services as described in *Chapter 4* and *6.2*), however, all habitats are inherently "multifunctional", i.e., capable of providing several different services. This means that practically all habitats contribute to the well-being of the region by creating economic benefits as well as values that cannot be expressed in monetary terms. The results of our work suggest, though, that intensive agricultural areas only marginally create added value. In designing different spatial development plans it is necessary to take account of the goods offered completely free by nature, as comprehensively as possible, together with the benefits that a particular area can provide and that appear in the economy or remain hidden.

**Cultural services** are of particular importance to local people. Of all the service types these are the ones that form the greatest part of their everyday lives, but these values cannot be expressed in terms of money at present. They can represent economic benefits as touristic attraction, which at present is

estimated at **17 million RON (3.8 million EUR)** annually. However, the research area is likely to possess even greater actual potential as the region is not regarded as a popular touristic destination at present. **Provisioning services** can be easily marketed in today's economic practice. They represent the economic foundation for local life. The economic worth of the four provisioning services that we assessed amounts to **34 million RON (7.5 million EUR)** per year. Of the provisioning services that we studied wood and timber, as well as natural fodder are of the highest value. They possess roughly the same economic potential.

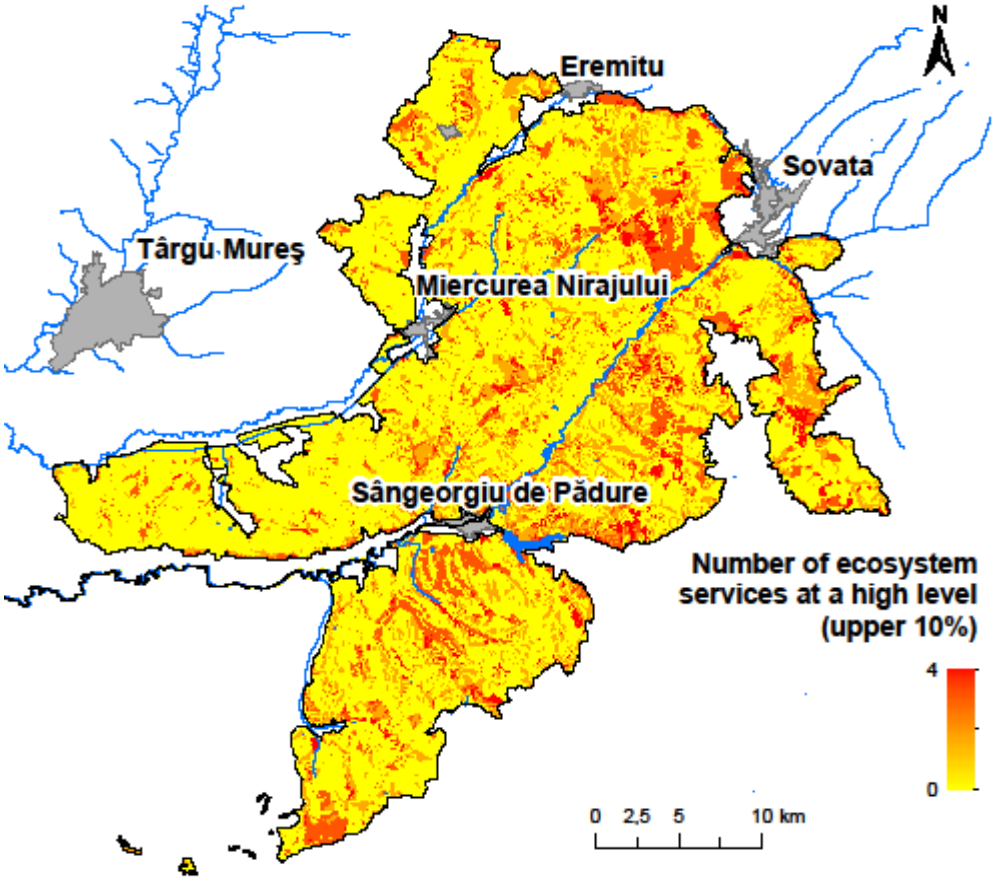


**Fig. 11.12:** Overview of ecosystem services in the Niraj - Târnava Mică region: the number of services provided at an outstanding level for each pixel

Mapping and assessing **regulating services** is highly challenging. For the local people their importance and value increases only as they become scarce. At present the area's water retention and self-purification capacities are particularly valuable since this is a globally scarce service by now. Pollination and climate change mitigation were ranked among the 12 key services despite the fact that the local communities have not yet or barely experienced their shortage. Although carbon sequestration has global market value, it can be realized only in the national budget but not in the local economy. This value is close to **6 million RON (1.3 million EUR)** per year.

**If the region lost some of these regulatory services** that are at present free, so that they would need to be replaced from elsewhere, **the costs** of these replacements would probably greatly exceed the amount that should be invested today to preserve them (e.g. EC 2013a, Levin 1983, Allsopp et al. 2008).

The people living in this region believe that preserving ecosystem services can be realized mostly in those **desirable scenarios** that are characterized by **strong community cohesion**. According to their

scenarios, a strong and cohesive community is able to compensate for the shortcomings of even weak legislation whereas in weak and divided communities even the best legislation cannot deliver results. However, for these strong and cohesive communities to make rational use of nature's assets and services, relevant knowledge and integrative thinking are also necessary.

Like in other parts of the world, the knowledge necessary to achieve this is lacking in this region as well. Even though there are local decision makers and land users (farmers, foresters, and beekeepers) who have the will to implement sustainable practices, they cannot prevail on their own and without relevant professional support.

Professional and political decision makers should make **decisions in an integrated fashion in** which they take into account multiple interests and factors simultaneously. It is the joint duty of land users and decision makers to ensure that the condition of and service flows from habitats could be preserved and maintained. Cooperation between the various actors is indispensable in this complex optimization problem, so that the region's overall capacity to provide ecosystem services could increase and maximally contribute to the local and national economy.

## 11.3 How to achieve the desired future - Policy recommendations

### 11.3.1 Romanian legislation in regard to ESs - conclusions from the policy analysis

Ecosystem services are certainly an emerging concept and a lot of research is still needed for a more consolidated integration into the policy making process. Romanian legislation shows recognition of ESs, especially through the transposition of various international conventions (e.g. CBD) or European Directives (WFD, Habitats and Birds Directive) and strategies (Biodiversity Strategy, Sustainable Development Strategy). Nevertheless, most legal texts bringing some recognition to ESs have to a large extent an advisory, guiding characteristic (for instance, all strategies). As previously mentioned, the strategies have no legally binding power and this aspect drastically hinders their implementation. Moreover, in most cases there is no budget allocated to implement the strategies (or where there is, most of the financing sources are uncertain), there are no clear responsible implementation bodies within the bureaucratic apparatus or where such bodies are mentioned, their tasks and responsibilities are missing. Consequently, while some of the strategies seem to be aligned to EU or international standards, in reality their implementation lags behind and the policy-making process they are supposed to guide is instead governed by a business-as-usual approach. On the other hand, when it comes to stronger pieces of legislation such as laws, the actual concept of ES is not completely integrated or understood and, more importantly, is not referred to directly or by using its terminology. Moreover, there are significant challenges in implementing the existing legislation and some legal parts with potential benefits to ESs are sometimes implemented in a way detrimental to them. For instance, some measures of the NRDP have had a negative effect on ecosystems and their functions and the same scenario can be met in the Law on Waters or the Forestry Code. Largely, this is due to a low awareness on what ESs are and which are their benefits and perhaps to the lack of scientific work and practical case studies in Romania, which would showcase the benefits of ES and enhance their integration in the decision making process.

### 11.3.2 Main policy recommendations for specific sectors

In addition to formulating policy recommendations based on the results of the national and regional policy analysis, we also addressed the question of how businesses regard external or internal regulations in relation to ecosystem services. Regulations pertaining, among others, to agriculture, land and water use, and nature conservation were considered key issues but no respondent of the survey made any reference to concrete legislation. Businesses involved in individual sectors highlighted only specific regulations directly impacting business operations. The lack of sufficient knowledge in the business sphere about regulations and the rationale behind them also results in low intrinsic motivation of businesses to observe laws and regulations. Providing relevant information to businesses about why regulations are necessary and how they can ensure medium and long-term sustainability of business operations while preserving the ecosystem services they rely on would also facilitate greater compliance with existing and future policies.

Our research shows that protected Natura 2000 sites provide a vast number of services to society – the total value of the six services selected in our research alone amounts to 57 million RON (13 million EUR) per year. Nevertheless, measures integrating and emphasizing the importance of ecosystem services are non-existent or are not properly applied. The following recommendations for decision makers offer help in how they can start preserving our natural assets for the future generations, with appropriate policies and funding.

#### Nature conservation and environmental policy recommendations

Natura 2000 sites form the largest network of protected areas in the world, designated under the EU Birds Directive[13] and Habitats Directive[14]. Funding and implementation of the Natura 2000 network are not adequate, despite the fact that even small investments in the sites deliver significant benefits (see Text box "Why invest in Natura 2000?"). In addition to the comprehensive implementation and adequate funding of Natura 2000 measures, the implementation of the international Convention on Biological Diversity and the EU Biodiversity Strategy 2020 could improve ecosystem service preservation efforts. Prioritizing habitat restoration and implementing the Green Infrastructure Strategy would enable a qualitative and quantitative improvement of ecosystem services. It is important that decision makers consider nature conservation a priority, and allocate sufficient funding and resources from national funds accordingly.

Local people identified 35 ecosystem services which they do not necessarily regard as values, and in most of the cases they are unaware of the risk of losing them. Awareness raising campaigns concerning natural assets and ecosystem services, support for activities from national and EU funds, as well as underlining the importance of natural resources in communication and education are crucial.

***To achieve this we recommend:***

*- Increasing the budget for Priority Axis 4 of the Large Infrastructure Operational Programme (POIM), specific references to ecosystem services and green infrastructure and prioritizing projects targeting this objective,*

[13] Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

[14] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

- *Funding measures in the Rural Development Programme (such as agricultural areas of high nature value) that facilitate the preservation of ecosystem services,*

- *Increasing funding for Operational Programmes and other state budgets that support related trainings and the improvement of nature conservation related human resources,*

- *Increasing the political and financial priority of the National Biodiversity Strategy,*

- *Integration of Natura 2000 sites in spatial planning processes, developing and implementing management plans for all Natura 2000 sites as rapidly as possible, and formulating tender specifications that allow appropriate expert organizations to apply,*

- *Increasing resources (currently 50 000 RON, ~11000 EUR) allocated to communication and education in the National Biodiversity Strategy and supporting additional awareness raising campaigns of high quality.*

## Why invest in Natura 2000?

The Natura 2000 network – the world's largest network of protected areas – covers 18% of the EU's land area. Annual maintenance and management costs amount to 5.8 billion EUR, while the socio-economic benefits of provided ecosystem services is estimated at 200-300 billion EUR annually (EC 2013b). The network plays an important role in mitigating natural disasters (e.g. droughts and landslides) through maintaining healthy and robust ecosystems and increasing the resilience of communities to the disasters. In addition, Natura 2000 sites represent significant touristic value; according to a 2011 report of the EU Directorate-General for the Environment, the network provides full-time employment for 4.5-8 million people (EEA 2012). Furthermore, the network contributes to economic growth on a national level as well – in Spain the Natura 2000 network increased GDP by 0.1-0.26%, while in France management activities of sites deliver 142 EUR per hectare. In the Netherlands the benefits of ecosystem services of Natura 2000 sites amount to 4.5 billion EUR per year (Gantioler et al. 2010, Nedelciu 2013)

## Climate policy recommendations

As the preservation of ecosystem services would also help to achieve climate policy objectives, we recommend taking greater account of ecosystem services in climate change mitigation and adaptation. Preserving and prioritizing habitats with high carbon sequestration capacity is of particular importance for climate change mitigation. In this respect, encroached grasslands are particularly important as they have carbon sequestration capacities twice as large as forests (IPCC 2006). The most important action for facilitating adaptation is the preservation of a diverse, multifunctional landscape of high nature value. Furthermore, water retention is expected to be of high importance, which is why all habitats that improve water retention and mitigate soil erosion should be supported (EC 2014). Encroached grasslands that form a mosaic of shrubs and groups of trees are also considered favorable in this respect. It would be important to develop subsidies for grasslands within the Rural Development Programme that help preserve these habitats and transform them into wood pastures.

***To achieve this we recommend:***

- *A detailed examination of the roles of protected and natural areas providing ecosystem services and greater emphasis on their roles in the National Climate Change Strategy and POIM (Priority Axis 5),*

- *With the aim of climate change mitigation, developing subsidies for grassland management that enable farmers to receive subsidies, even if there are bushes or trees on it.*

## Business related policy recommendations

Our survey conducted among businesses shows that there is no sufficient knowledge in the business sphere about ecosystem services and their underlying factors, not even in areas directly impacting the activities of specific businesses (e.g. businesses in the tourism industry did not attach high importance to landscape diversity). Due to their lack of knowledge none of the businesses have integrated these services and their sustainable use into their operations. No internal rules (e.g. sustainability strategy) exist in terms of ecosystem services. As the business entities appear to be unaware of the requirements necessary for their operations, their medium and long-term sustainability can be questioned. It is essential that businesses integrate services in their business plans and be aware of their dependence on these services and how they can manage it. Funds facilitating the catching-up process of the economy need to incorporate this important aspect and offer good practices and expertise to assist primarily more vulnerable small and medium-size businesses.

***To achieve this we recommend that:***

- *The Operational Programme improving competitiveness include references to the sustainability of businesses, more specifically to their dependency on ecosystem services and introduce trainings and consulting services on integrating the services into business operations.*

## Water related policy recommendations

The service deemed most important by locals was water retention, mostly because its lack and related problems have already impacted people's everyday lives. Despite the important role of water and water retention, only 193 water bodies in the country are in good ecological status out of 681 designated by the Water Framework Directive (EEA 2012).

In order to preserve water retention in the long term and improve the ecological status of waters it is necessary to create a basis for sustainable water management. Water management needs to take an integrated approach and address the river basin area as a whole in a complex manner instead of only focusing on streams. Drastic riverbed transformation measures should be replaced with more natural solutions, such as restoring floodplains and protecting forests of river basins (EC 2012). Wetland conservation – supported also by EU and international conventions – should be a priority. Water retention and good water quantity should be achieved among others by undertaking small-scale water retention measures, as well as by improving water-efficiency and water conservation practices (e.g. drip irrigation, precipitation retention, and permanent plant cover). Measures to stop water contamination should include strengthening environmental protection standards for forestry and agriculture, and developing an appropriate incentive scheme.

***To achieve this we recommend:***

*- A full implementation of the Water Framework Directive until 2020,*

*- Proper integration of natural water retention measures (see Textbox "Natural water retention measures") into river basin management plans,*

*- Strengthening wetland conservation and implementation of appropriate management measures,*

*- Greater support through the Rural Development Programme for measures that enable water-efficient practices and water retention measures,*

*- Ensuring strict compliance with the Nitrates Directive and other environmental regulations aiming to curb pollution and informing the public and users,*

*- Developing an incentive scheme especially for primary polluters that motivates them to favor appropriate management instead of water contamination,*

*- Implementation of communication campaigns that raise awareness of the importance of and options for preserving good water quality and quantity.*

### Natural water retention measures

Natural water retention measures (NWRM) is essential in improving the quality of European waters, especially in mitigating the effects of floods and droughts. NWRM incorporates multifunctional measures (e.g. building buffer strips, mulching, conserving floodplain forests or restoring the natural form of water bodies) that aim to conserve water sources (EC 2014). They address water related challenges by preserving the natural characteristics of ecosystems and water bodies and using natural tools and processes. NWRM methods improve or restore the water retention of natural or man-made soils and aquatic ecosystems, drinking-water quality and the chemical and ecological status of water bodies by restoring naturally functioning ecosystems and services provided by them. Restored ecosystems are essential in climate change mitigation and adaptation, reducing incidence of waterborne diseases, flood protection, storm protection, the production of good biomass, and improving services related to nature conservation. In addition to involving less energy and infrastructure investment, the environmental impact of using NWRM is also significantly lower than that of river basin reconstruction. Funding of NWRM measures is supported by national funding resources as well as EU funds (e.g. different LIFE projects, Rural Development Programme, Cohesion and Structural Funds, NWRM 2013 a,b)

## Policy recommendations related to culture and local identity

Local identity and strong community cohesion are highly important to respondents regardless of age, gender or profession. It is important to halt the current high level of emigration, through offering adequate employment opportunities, infrastructure and leisure programs (e.g. sports communities, choirs and groups formed to preserve local customs). Adequate expertise, training and demand are needed to revive and sustain traditional professions (Turner et al. 2011). It is also important to facilitate the acceptance of minority groups, as well as their social and economic integration, in order to bind communities together. To this end, integration and poverty alleviation strategies need to be developed that reflect possible solutions to potential conflicts. These need to be incorporated into local and regional development strategies. Well-equipped schools and hospitals are essential, too, in places where municipalities have greater flexibility in development decisions. Furthermore, it is crucial to

develop and implement appropriate national strategies and provide structural funds, primarily in education and health care.

***To achieve this we recommend:***

- *Strong support for local social infrastructure developments and for the creation of traditional jobs, within the framework of the Operational Programmes targeting competitiveness and regional development,*

- *Integrating aforementioned objectives (e.g. job creation, infrastructure, community building) into regional and county-level development plans,*

- *Prioritizing the poverty alleviation components in these development plans.*

## Tourism related policy recommendations

Tourism is one of the potential leading economic sectors in the region. For tourism to build on ecosystem services and to contribute to their preservation, it is essential to develop soft tourism focusing on small-scale, local, natural and cultural values. Adequate small-scale infrastructure (smaller high-quality catering/food service establishments/restaurants, nature trails, cycle paths, renovated public spaces, drinking water wells, and public restrooms) is needed along with spatial planning regulations that preserve traditional landscapes and villages. To attract tourists it is also important to take stock of natural assets and provide relevant information to tourists (e.g. maps), develop appropriate promotion strategies for the region, offer attractive programs and adequate expertise. This requires financial support for regional and local tourism organizations. Furthermore, it is possible to introduce a special tourism related tax that is allocated to a separate fund supporting touristic infrastructure development.

***To achieve this we recommend:***

- *Highlighting the importance of small-scale environmentally friendly tourism in the National Tourism Development Master Plan,*

- *Supporting small-scale environmentally friendly tourism (supporting job creation, developing local tourism infrastructure, as well as compiling and disseminating relevant information) in the framework of the Operational Programmes targeting competitiveness and regional development,*

- *Launching high quality educational programmes for the region's tourism enterprises-entrepreneurs,*

- *Developing a financing mechanism e.g. in the form of a special tax whose revenue only serves the development of touristic infrastructure,*

- *Establishing local, small-region, county or regional level tourism associations that perform primarily promotional, advocacy and human resource development tasks.*

## Policy recommendations related to agriculture and apiculture

Many ecosystem services assessed in our study are strongly influenced by the current EU agricultural policy. Land and non-performance-based subsidies benefit intensive agriculture and large-scale farmers thus jeopardizing the mosaic landscape and related natural assets. Single area payment schemes benefit intensive agriculture and large-scale farmers across the EU and significantly contribute to the decline of natural assets in quality and quantity (Nedisan & Pruneau 2014). In order to preserve the local traditional landscape and society, it is important to favor small-scale farmers and

those who contribute to the preservation of natural assets. It is therefore necessary that payments be allocated based on quality performance instead of land area. To achieve this, we recommend that the agri-environmental programs (*ro:* agromediu) to be redrawn in a flexible approach, in which farmers may choose voluntarily from a set of criteria, and the actual payments based on performance (thus if they fulfil more criteria, they receive more payment). Nature conservation and related requirements should be included among the key objectives of these criteria.

Reviewing target areas related to the already existing agricultural subsidy schemes is also necessary, as traditional orchards of the Niraj and Târnava Mică region, for instance, are not included under any of these schemes. Without including traditional orchards in the target areas, local orchard owners are not eligible for agricultural subsidies for the renewal of their plantations, and areas traditionally engaged in fruit production such as Vădaș (municipality of Neaua) are thus losing the potential to benefit from it.

In order to create better employment opportunities in the field of agriculture, products should be locally processed and sold in processed form. This requires support for the local small-scale processing industry in the form of enabling farmers without substantial capital to become involved in this industry, too. The current requirement of 50% own contribution is too high for many local farmers and entrepreneurs. Furthermore, strict hygiene rules pose an additional significant obstacle in selling processed products (vegetables, fruits, or cow's milk). Weakening the strict hygiene requirements – along with the agri-environmental subsidies promoting cattle farming in the framework of the Rural Development Programme modified in 2015 – would provide more incentives for cattle farming in the region (which would play a role in maintaining the mosaic landscape, reinvigorating traditional cattle grazing and curbing the more environmentally destructive sheep grazing).

To make small-scale farmers and their products competitive, potential opportunities under the subsidy scheme need to be made available. This requires a transparent subsidy scheme, providing relevant information and professional advice to farmers.

The number of beekeepers in the Niraj and Târnava Mică region is particularly high. Nonetheless, honey produced in this region is an important service not for its quantity but for its high quality, due to species-rich semi-natural bee pastures.This applies particularly to honey collected from traditional meadows and pastures. Unfortunately, however, large declines in meadow area have been witnessed and pastures are under increasing pressure from the growing number of animals. However, with smaller changes in land use practices, the above problems could be solved and the quantity of honey increased.

It is important to assess and develop the potential market for locally processed products by supporting awareness raising efforts, elaborating relevant campaigns and product development strategies, and providing relevant training for farmers (e.g. branding, promotion, marketing, sales, business studies). Developing local products, as well as their brand and communication plays a role in persuading consumers, and thus financial support should be provided to local businesses. Short distribution chains should be popularized and functionalized, too. The LEADER program could provide an appropriate source of funding, with the condition that local action plans include specific requirements for local product development.

Targeting the market also requires cooperation among farmers. To achieve this, establishing agricultural cooperatives should be incentivized. Furthermore, it is important to create room for farmers to establish relationships, thus strengthening cooperation. Ensuring relevant expertise among

local farmers is essential for developing the agricultural sector. Firstly, it would be important to support trainings that facilitate the production of healthy products and protection of clean drinking water (e.g. chemical and fertilizer-free or water-efficient farming). In addition, it is essential to ensure high quality vocational schools (of an adequate standard) for future farmers. This requires obtaining an adequate level of professional practice that should be integrated into vocational school curricula as a compulsory element. It is also recommended that model farms to be established, which would provide opportunities to present sustainable agricultural practices.

***To achieve this we recommend:***

- *Reviewing and reforming the Common Agricultural Policy so that payment is based on performance and results,*
- *Reviewing the current Rural Development Programme before 2021 and increasing subsidies for ecosystem service conservation (e.g. soil and water protection),*
- *Developing an agricultural subsidy scheme based on quality performance that builds on a set of criteria in a flexible approach taking into account the protection of environmental assets,*
- *Reviewing the agricultural scheme target areas in the Rural Development Programme,*
- *Greater support to small-scale farmers through subsidies to finance their own contribution or ensuring pre-financing loans, and revising hygiene requirements to facilitate sales of processed products,*
- *Subsidizing chemical-free ploughland production and bee pasture cultures (phacelia, lucerne, clover),*
- *Creating bee-pastures in public spaces of settlements (planting fruit trees)*
- *Preserving meadows with using traditional management techniques, in particular above 500 m a.s.l.,*
- *Better exploitation of green infrastructure elements (hedges, rows of trees) and promotion of their advantages among farmers,*
- *Regulating the number of grazing animals to prevent over-grazing,*
- *Subsidizing the preservation of the traditional mosaic agricultural landscape,*
- *Developing the infrastructure and human resources connected to the Rural Development Programme and the Common Agricultural Policy,*
- *Improving opportunities for communication and information exchange among farmers,*
- *Developing and promoting relevant trainings (e.g. business, marketing, branding and sales knowledge, traditional agricultural practices - both in adult and youth education),*
- *Designing awareness raising campaigns targeting purchasing power,*
- *Elaborating subsidies that enable the establishment of strong cooperatives.*

## Forest and foraging related policy recommendations

To preserve ecosystem services provided by forests it is necessary to adopt sustainable forestry practices. It is essential to implement land consolidation, to strengthen requirements for logging permits, and to ensure greater compliance with nature conservation laws. It would be important that

municipalities be able to regularly monitor forestry operations and compliance of rules. It would also be essential to value forests based not only on timber quality but also according to other ecological and cultural services, these factors should be integrated into the price of forest products, and taken into consideration in the forestry management plans.

To achieve sustainable logging, log exports should be restricted by imposing duties. To keep timber in the region, wood processing should be performed by local businesses that could initially receive state and EU funding. Woodlands outside of the current forestry fund should be treated as forests, and adequate compensation should be provided to owners of Natura 2000 sites. Due to the legal status of the Natura 2000 sites and related nature conservation requirements, forest owners from these sites would need compensation as a reimbursement for lost income incurred due to logging restrictions. Forest foraging should be permitted under a reasonable set of rules.

***To achieve this we recommend:***

- *Introducing stronger requirements for logging permits and their inspection,*
- *Integration of other ecosystem services of forests (non-wood/timber) into forestry management plans,*
- *Elaborating Natura 2000 payment schemes for forests in the framework of the Rural Development Programme,*
- *Regulating foraging activities in the forest so as to prevent the overexploitation of forests and their services and at the same time enable the sustainable use of those services for society.*

## 11.4 Summary of main project results

This work was originally conceived as a 'regional MAES case study', i.e. a policy-oriented research project that aims at mapping and assessing key ecosystem services in a specific region following the guidance set out by the EU MAES (Mapping and Assessment of Ecosystems and their Services) working group. We adapted MAES-compliant techniques in a participatory manner to a traditionally managed European rural area particularly rich in natural heritage. Thus the lessons learned from the Niraj-MAES project can significantly support the future national and EU-level implementation of Target 2/Action 5 of the EU Biodiversity Strategy. Our results have already been presented at various national and international conferences (Czúcz et al. 2016, Vári et al. 2016), and further publications are forthcoming. Our work, which also features methodological innovations, is one of the first Romanian examples of a comprehensive and participatory regional MAES study.

We have experienced that a deep involvement of local communities throughout a research process demands considerable amounts of time and efforts. However, this is absolutely necessary for establishing a cooperative atmosphere with stakeholders, and acceptance of the research outcomes. The involvement of the local communities has already triggered a mutual learning and awareness-raising process during our work. And, eventually, one of the main results of the scenario building process, pointed out by a broad range of local people was that community cohesion is particularly important from the aspect of their own future and the preservation of ecosystem services. This also underlines the significance of local participation – not only in research projects, but also in everyday governance. An inclusive governance through well-functioning local-level institutes of participation

may require considerable efforts and resources, but by increasing awareness and social cohesion it also increases the resilience of the local socio-ecological system, and thus pays off in the long run.

Through the various activities implemented during the project it became obvious, that in certain fields people lack awareness about the presence and/or the significance of various ES, while they are generally well informed about some other ES which are more conspicuously present in the media or the education. The first step in preserving nature and ecosystem services is to recognize the value of these assets, i.e. the well-functioning ecosystems and the full spectrum of services they provide.

We could see and document that it is dangerous to strive for maximizing the yields of any specific ecosystem service and neglect others. We have to keep in mind that multiple interactions between the different ESs exist and a maximal use of one might therefore easily result in the deterioration – and even endangerment – of several other ESs. An early inclusion of all relevant sectors and stakeholder groups is therefore vital.

One special characteristic of the Niraj and Târnava Mică region is the relatively rich natural heritage, including a wealth of rare species, protected ecosystems, ancient land-use patterns, and the related traditional knowledge still alive in the region. However, this rich natural and cultural heritage, created by the sustainable cooperation of people and nature through the centuries, is rapidly eroding. There is a broad range of ecological and social problems within local societies, as well as on the regulatory level. To overcome these issues poses a great challenge to the future. In principle both social and ecological diversity, as well as the survival of the related traditional ecological knowledge can greatly contribute to the sustainability of the region. In our ever-changing and unstable world the rapidly eroding traditional ecological knowledge is of irreplaceable value as a potential source of future resilience.

As the results of the present work also bear witness to, we have to tackle these problems from two directions: bottom-up, i.e. increase/sustain community cohesion – which lies in the hands of the community, community leaders, etc.) and top-down from a (higher) legislation perspective – for which we made several suggestions in the previous chapters of this report.

With our work we aimed to start a responsible dialogue about the future in the region of Niraj and Târnava Mică rivers. We hope that the dialogue we started will continue even after the research is finished, and that our ideas will materialize through the beauty and values of the region, and the enthusiasm of the local people.

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# 12. Appendices

## 12.1 Abbreviations

**AB** - Advisory Board
**AEM** – Agri-environment Measures
**ANAR** – Romanian Agency for Water Management (Agentia Nationala a Apelor Romane)
**ANC** – Areas of Natural Constraint
**APIA** - Agenţia de Plăţi şi Intervenţie pentru Agricultură
**APM** - Agenția de Protecția Mediului
**CAP** – Common Agricultural Policy
**CBD** – Convention on Biological Diversity
**CE** – Council of Europe
**CICES** – Common International Classification of Ecosystem Services
**DRBMP** – Danube River Basin Management Plans
**EEA** – European Environment Agency
**EIA** – Environmental Impact Assessment
**ES** – Ecosystem Service
**EU** – European Union
**EUR** – Euro
**FLF** – Romanian national Forest Land Fund
**GD** – Government Decision
**GDP** – Gross Domestic Product
**GO** – Government Ordinance
**GOV** – Government
**HNV** – High Nature Value
**IPCC** – Intergovernmental Pael on Climate Change
**MAES** – Mapping and Assessing Ecosystems and their Services
**MARD** – Ministry of Agriculture and Rural Development of Romania
**MEA** – Millenium Ecosystem Assessment
**MEF** – Ministry for European Funds
**MO** – Ministerial Ordinance
**MS** – Member State
**NBSAP** – National Biodiversity Strategy and Action Plan
**NGO** – Non-governmental Organisation
**Niraj-MAES** – Mapping and Assessing Ecosystem Services in the Niraj – Tarnava Mica valley
**NRDP** – National Rural Development Programme
**NSCC** – National Strategy on Climate Change
**NSDS** – National Strategy on Sustainable Development
**OP** – Operational Programme
**PA** – Priority Axis
**POIM** – Big Infrastructure OP (Programul Operational Infrastructura Mare)
**QS** – QuickScan
**RBMP** – River Basin Management Plan

**RON** – Romanian currency
**SAB** - Stakeholder Advisory Board
**SAC** – Special Areas of Conservation
**SCI** – Sites of Community Interest
**SDS** – (EU's) Sustainable Development Strategy
**TEEB** – The Economics of Ecosystems and Biodiversity
**TO** – Thematic Objective
**UK** – United Kingdom
**UNDP** – United Nations Development Programme
**UNEP** – United Nations Environment Programme
**UTCB** – Technical University of Civil Engineering (Universitatea Tehnica de Constructii Bucuresti)
**WFD** – Water Framework Directive

# 12.2 Related content

## 12.2.1 Short summary studies

- Summary study about scenario planning:
  WHAT IS THE WAY FORWARD? Scenarios for the Niraj - Târnava Mică region with relation to ecosystem services
- Summary study about mapping and assessing:
  HOW MUCH ARE NATURE'S GIFTS WORTH? Summary study of the mapping and assessment of ecosystem services in Natura 2000 sites of the Niraj - Târnava Mică region

## 12.2.2 Sector briefs

- Water management related policy recommendations:
  SERVICES NATURE PROVIDES US - Water management related policy recommendations for decision makers
- Tourism related policy recommendations:
  SERVICES NATURE PROVIDES US - Tourism related policy recommendations for decision makers
- Policy recommendations related to forest and game management recommendations:
  SERVICES NATURE PROVIDES US - Policy recommendations related to forest and game management for decision makers
- Agriculture related policy recommendations:
  SERVICES NATURE PROVIDES US - Agriculture related policy recommendations for decision makers

# 12.3 Questionnaires

## 12.3.1 Survey photo elicitation

**Cartarea serviciilor de ecosistem în siturile Natura 2000 din regiunile Valea Nirajului și a Târnavei Mici (31.07-02.08.2015)**

**Numele operator de sondaj:** **Localitatea:**

⇒ *Interogarea persoanelor:*

Bună ziua! Efectuăm un sondaj de opinii în localitatea ....., despre importanța peisajului pentru oamenii din Valea Târnavei Mici/Valea Nirajului. Ați dori și dvs. să colaborați și să ne răspundeți la câteva întrebări? Răspunsurile dvs. sunt anonime și vor fi păstrate și prelucrate confidențial.

⇒ *Prezentarea afișului:*

Pe acest afiș am colectat fotografii și imagini din zonă și reprezintă bunurile și valorile oferite de mediul natural din zonă. Uitați-vă la imagini, gândiți-vă care vi se par importante și alegeți 5 imagini care credeți că reprezintă cele mai importante valori naturale pentru comunitățile locale și pentru cei care vizitează această zonă.

**A. Set 1 de întrebări: aranjarea fotografiilor**

**A.1.1.** Imaginea aleasă pe locul 1:.....

**A.1.2.** De ce ați ales această fotografie? (De ce vi se pare importantă obiectul/imaginea aleasă?)

.....

.....

**A.2.1.** Imaginea aleasă pe locul 2:.....

**A.2.2.** De ce ați ales această fotografie? (De ce vi se pare importantă obiectul/imaginea aleasă?)

.....

.....

**A.3.1.** Imaginea aleasă pe locul 3:.....

**A.3.2.** De ce ați ales această fotografie? (De ce vi se pare importantă obiectul/imaginea aleasă?)

.....

.....

**A.4.1.** Imaginea aleasă pe locul 4:.....

**A.4.2.** De ce ați ales această fotografie? (De ce vi se pare importantă obiectul/imaginea aleasă?)

.....

.....

**A.5.1.** Imaginea aleasă pe locul 5:.....

**A.5.2.** De ce ați ales această fotografie? (De ce vi se pare importantă obiectul/imaginea aleasă?)

.....

.....

**A.6.** Puteți să enumerați alte valori naturale regiunii Valea Nirajului/Valea Târnavei Mici care vi se par importante dar nu au fost ilustrate prin imagini? *(Scrie răspunsul cuvânt cu cuvânt)*

.....

.....

**A.7.** Alte observații despre imagini *(Notează informațiile suplimentare interesante!)*.....

.....

Implementat de: Parteneri:

### 12.3.2 Questionnaire for valuating touristic attractiveness (travel cost method)

## Questionnaire

We are carrying out a survey with questionnaire analysis among visitors of this place. The aim of the survey is to measure what attracts the visitors the most and how much they are willing to pay for their journey. Would you be so kind and answer several questions in this context?
The questionnaire is anonymous, only takes 5-10 min to fill out.

Code of the questionnaire (monogram + number of the questionnaire, e. g. KÁ-1):.....
Location:…….....
Date:…….
Interviewer's monogram: ……..

**Questions related to traveling:**

**1.** For what purpose did you visit this place? (More answers can be given)

**1.1** Free time activities **1.2** Work **1.3** Visiting relatives
**1.4** Research **1.5** Passing through **1.6** Other: ……..

2. Where do you live (name of the city/village)?

3. How many kilometres did you travel to get here?

4. How many hours did you spend with travelling to get here?

5. By which vehicle did you travel to get here?

**5.1** Bus **5.2** Train **5.3** Car
**5.4** Motorcycle **5.5** Airplane **5.6** Bicycle **5.7** By walk
**5.8** Other: …….

6. How much did the travel cost (bus or train ticket, gasoline, etc.) to get here?

7. How many of you were travelling by the same vehicle (only in case of car or motorcycle)?

8. How much time do you spend in the area during your journey in the area?

**8.1** Few hours **8.2** One day **8.3** A couple of days **8.4** More weeks or more
**8.5** Other:.....

9. How often do you visit this place?

**9.1** Weekly **9.2** Monthly **9.3** Yearly more times **9.4** Yearly

**9.5** Less than yearly **9.6** This is my first time

10. What kind of programs do you plan for your visit?

**10.1** Hiking **10.2** Rowing **10.3** Other sport

**10.4** Visit characteristic fauna and habitats (bear-watching, observing other wild animals, birding)

**10.5** Fishing, hunting **10.6** Collect wild plants (herbs, mushrooms, berries)

**10.7** Visiting characteristic geological objects **10.8** Taking photos **10.9** Churches

**10.10** Historical and spiritual walks e.g.: Road of salt, Road of Mary **10.11** Historical memorials (e. g: Roman), museums

**10.12** Traditions, folklore (view of the village, farming methods, crafts, folkways, food, country houses)

**10.13** Buying local, traditional products **10.14** Festivals, cultural events

**10.15** Other: ……..

11. Which of these activities you would suggest improvements and developments?

**11.1** Hiking **11.2** Rowing **11.3** Other sport

**11.4** Visit characteristic fauna and habitats (bear-watching, observing other wild animals, birding)

**11.5** Fishing, hunting **11.6** Collect wild plants (herbs, mushrooms, berries)

**11.7** Visiting characteristic geological objects **11.8** Taking photos **11.9** Churches

**11.10** Historical and spiritual walks e.g.: Road of salt, Road of Mary **11.11** Historical memorials (e. g: Roman), museums

**11.12** Traditions, folklore (view of the village, farming methods, crafts, folkways, food, country houses)

**11.13** Buying local, traditional products **11.14** Festivals, cultural events

**11.15** Other: ……..

12. What other costs occurred related to your journey (entrance tickets, tourist guidance fee, accommodation)?

| **Cost item** | **13. How much did these cost approximately?** |
|---|---|
| | |
| | |
| | |
| | |
| TOTAL: | |

14. If you are on a round trip which other destination do you visit?

15. Did you take an insurance?

**15.1** Yes **15.2** No **15.3** I do not know

16.If YES, how much did it cost?

**Personal data:**

17. Monthly income/head in the household (lei)
**17.1** 0-200 **17.2** 201-500 **17.3** 500-1000 **17.4** 1000-1500 **17.5** More than 1500

18. Holiday days/year
**18.1** 0-10 **18.2** 11-20 **18.3** 21-30 **18.4** 31-40 **18.5** Other:.....

19. Education
**19.1** Elementary school (8 grade) **19.2** High school **19.3** Higher education (College or University) **18.4** Other:……

20. Age
**20.1** Under 18 **20.2** 19-30 **20.3** 31-45 **20.4** 46-65 **20.5** Over 65

## 12.3.3 Local business survey (dependence analysis)

**Chestionar pentru evaluarea economică**

Bună ziua! Efectuăm un sondaj de opinii în localitatea ……, despre importanța peisajului, naturii pentru întreprinzătorii din Valea Târnavei Mici/Valea Nirajului. Ați dori și dvs. să colaborați și să ne răspundeți la câteva întrebări? Răspunsurile dvs. sunt anonime și vor fi păstrate și prelucrate confidențial. Completarea chestionarului durează cca 10minute.

Codul chestionarului..... Monogramă operator: ……..

Denumire persoană juridică:…….. Localitate……

Data:……

**1. Profilul firmie/activități:**

**1.1** Creșterea animalelor **1.2** Cultivarea plantelor **1.3** Florărie **1.4** Farmacie **1.5** Magazin de plante medicinale **1.6** Producere de băuturi răcoritoare, apă minerală, apă sifon **1.7** Măcelărie **1.8** Faiskola **1.9** Silvicultură **1.10** Exploatarea lemnului **1.11** Turism **1.12** Industria construcției **1.13** Cofetărie **1.14** Coafură, cosmetică **1.15** Transport persoane **1.16** Prelucrarea lemnului **1.17** Comerțul cu amănuntul al îmbrăcămintelor **1.18** Apicultură **1.19** Apă, gaz, electricitate **1.20** Vulcanizare **1.21** Service auto **1.22** Prelucrarea lânii **1.23** Comercializare mobilă **1.24** Comerț papetărie **1.25** Pescuit **1.26** Industria alimentară **1.27** Moară **1.29** Construcții drumuri **1.31** Altele……

**2. Numărul angajaților:**

**3. În cele ce urmează enumerăm câteva bunuri asigurate de natură. Vă rugăm, exprimați în cifre de la 0 la 5 cât de mult depindeți de aceste bunuri!** (Cât demult folosiți în activitățile dvs. aceste resurse?)

(0: deloc, 5: în totalitate)

| Serviciul ecosistemic | Dependența | | | | | |
|---|---|---|---|---|---|---|
| Diversitatea naturii (biodiversitate) | 0 | 1 | 2 | 3 | 4 | 5 |
| Fertilitatea solului | 0 | 1 | 2 | 3 | 4 | 5 |
| Făn, nutrețuri | 0 | 1 | 2 | 3 | 4 | 5 |
| Material lemnos | 0 | 1 | 2 | 3 | 4 | 5 |
| Plante medicinale, ciuperci, fructe | 0 | 1 | 2 | 3 | 4 | 5 |
| Miere, nectar | 0 | 1 | 2 | 3 | 4 | 5 |

Implementat de: Parteneri: