

## AN ECOSYSTEM SERVICES APPROACH IN THE TISZA RIVER BASIN

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*Minca, E. L., Petz, K. and Werners, S. (2007): An ecosystem services approach in the Tisza River Basin. — Tiscia 36, 35-40*

**Abstract.** The Tisza River Basin in Hungary and Romania is increasingly impacted by floods and droughts. Ecosystems have the capacity to mitigate the effect of these weather extremes. The provision of ecosystem services – the benefits people obtain from ecosystems – is strongly affected by the way in which ecosystems are managed. This research assesses the influence of land and water management and weather extremes on ecosystems services as well as their importance in the Tisza River Basin. It is concluded that current water management impairs the natural capacity of ecosystems to fully provide their services, especially the water regulation, natural hazard regulation and water purification. For years water management has favoured wetland drainage and cutting river arms, ignoring ecosystem services. Recently some of the water and land management initiatives – in particular in Hungary – aim to capitalize on the potential of ecosystems to regulate floods and droughts.

*Keywords:* ecosystem services; integrated assessment; water and land management

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### Introduction<sup>1</sup>

The Millennium Ecosystem Assessment (MA) defines ecosystem services as the benefits people obtain from ecosystems (MA 2003). Thus ecosystem services support human well-being. The provision of ecosystem services is highly influenced by factors such as climatic conditions and water management. The combined effect of past and current human management, floods and droughts and climate change has resulted in ecosystems whose capacity to generate ecosystem services has been degraded (Folke *et al.* 2004). Although it is increasingly recognized scientifically that human well-being depends critically on all ecosystem services, they are often neglected in planning (de Groot 2006). The Tisza River Basin in Hungary and in Romania is

increasingly facing the impacts of floods and droughts (Hungarian Academy of Science, 2006). The inclusion of ecosystem services in spatial and policy planning is important since an adequate inclusion may have the capacity to reduce or mitigate the effect of climate related extremes.

The aim of the research is to assess the influence of land and water management and weather extremes on ecosystems services as well as their importance in the Tisza River Basin. The paper distinguishes between three main classes of ecosystem services: provisioning services (e.g. providing food and raw materials), regulating services (providing flood regulation and erosion control) and cultural services (e.g. recreation and cultural value).

In the light of climate change, Balogh (2001) argued that merely the current structural measures for fighting water (e.g. dams, dykes and canals) might prove ineffective for protecting the natural and human environment. Instead, the idea of natural water retention, which holds water in former natural waterways – floodplains and oxbows – is emerging (Botos *et al.* 2002). Water retention also enhances the revitalization of water-dependent ecosystems and

<sup>1</sup> The conducted research is part of the “Adaptation and Mitigation Strategies” EU-project (ADAM; [www.adamproject.eu](http://www.adamproject.eu)). The Tisza River Basin was chosen by ADAM to illustrate distinct climate-change related environmental problems and a range of regional environmental policy challenges.

it is highly connected with land use and land management. In the engineering dominated water management system along the Tisza (e.g. water regulated by dams, dykes and canals) the ecosystems are restricted in providing their services. Especially the regulating services are affected. A more natural system facilitates the natural capacity of ecosystems to deliver services. In this context, multi-functional land use that implies more than one function per unit of land, gains attention (Rodenburg *et al* 2002). To assess the influence of water management practices and land use change on the ecosystem services, two cases are analyzed and compared in the Tisza River Basin. The data processing is based on information collected through literature, interviews and field observation. The results underline that the structural water management measures and the underestimation of the benefits provided by ecosystems leads to a reduced performance of ecosystem services.

## Methods

The MA (2003) defined the term “ecosystem services” as the benefits people derive from ecosystems including the functional processes and components of the ecosystems providing them. The MA typology established the following categories of ecosystem services: provisioning services, regulating services, supporting services and cultural services. This study adopted the term and classification of ecosystem services from the MA framework. The selection of investigated ecosystem services relies both on the MA and de Groot (2002) typologies.

Seven land cover types – arable land, grassland, forest, orchard, wetland, water body and urban environment – were investigated in the study areas. For each a set of fourteen ecosystem services was chosen, representing the three main classes of services:

- Provisioning services: food, freshwater, raw materials, genetic resources and medicinal resources;
- Regulating services: water regulation, water purification, erosion control, pest regulation, natural hazard regulation and soil quality regulation;
- Cultural services: aesthetic value, recreation and ecotourism and cultural value.

The selected cases are the Bereg Region in Hungary and the Crișuri Plain in Romania (Fig. 1). The Bereg Region, as a consequence of being protected by dykes directly on the Tisza River, faces high inland water stagnation risk but still increased

flood risk (Balogh 2001). To mitigate the risks emerging from the inappropriate water management and to utilize the water in a more efficient way a specific water management project was developed – in the frame of the Hungarian-Ukrainian European INTERREG Neighbourhood Programme. The project aims to design a water retention based management and mosaic land use by establishing a water retention polder near Jánd village (European INTERREG Neighbourhood Programme of Hungary and Ukraine 2006).

The Crișuri Plain case is less exposed to flood risks due to its slightly hilly setting along the Crișul Negru River. Here the new water management plan, initiated by the Ministry of Environment, focuses on the creation of wet areas in three artificially cut river bends that are partly surrounded by dykes near Tinca village. The aim of the plan is to improve the water flow in case of high water level and increase the tourism activities (Dimache 2007). However, there is no specification about the newly created ecosystems in the wet areas. The water management plans will affect 75% of the Hungarian case region, compared to only 5% in the Romanian case.

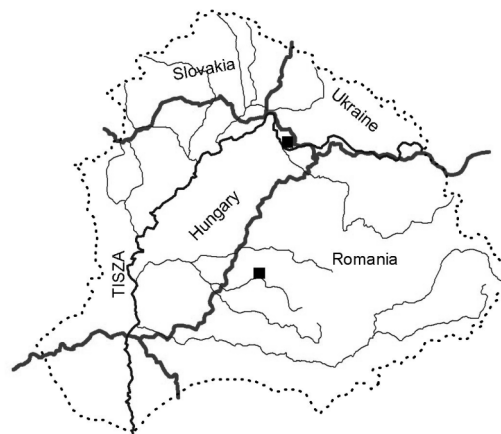


Figure 1. Location of the two case studies in the Tisza River Basin

In order to assess ecosystem services in the context of land and water management and weather extremes, the terms “performance” and “recognition” are introduced. The performance is considered as the degree at which an ecosystem service is delivered. At the same time, recognition stands for the perception of ecosystem services by the people, pointing at the extent at which these services are important to people. The selected ecosystem services were investigated with the help of different environmental indicators. Examples for indicators are the condition and number of canals for the water

regulation service or yield/ha for the food production service. The indicators served as backbone of the interviews and the field observations during the three months fieldwork both in Hungary and Romania.

We used a semi-structured interviewing technique based on the indicator list. The interviewees ranged from scientific experts and higher level stakeholders (e.g. climatologists and water management boards) to local authorities and local agents (e.g. mayors and NGO representatives). In both cases approximately twenty interviews were conducted with an even distribution between the above mentioned categories. The findings offered a good insight on the power web of stakeholders, the stage, opportunities and restraining factors of the land and water management plans, as well as useful information about the indicators of ecosystem services and flood and drought regimes.

The one week field observation served the better understanding of the studied phenomena. The observation was documented using a check list and the findings were summarized in an observation report. Moreover, numerous pictures were taken in order to visualize the physical condition of ecosystems.

The investigated written documents consist of scientific articles, books, as well as internal reports and statistics from stakeholders.

The collected information was used to evaluate ecosystem services on a four-step scale, where “0” stands for no performance/recognition and “3” for high performance/recognition. We assigned these values subjectively based on the overall view obtained from all information sources.

## Results

This section summarizes the findings about how land and water management, weather extremes and perception affect ecosystem services in the Tisza River Basin.

Regarding the influence of weather extremes on ecosystem services, the food provisioning service is perceived to be the most impacted, followed by several regulating services. The high perceived affectedness of the food is emerging from the fact that there is considerably more literature available on the observed effect of weather extremes on food compared to the other services. The cultural value and aesthetic value are the least impacted.

The interviews showed that people associate specific ecosystem types with certain services. First of all, the food provided by the arable land is the most valued ecosystem service by locals (Photo 1). Furthermore, the recreation possibilities provided by the Tisza River bank in the Bereg and the forests in

the Crișuri Plain are highly appreciated by the villagers. On the contrary, food provided by waters and forest are less recognized and hardly any services are assigned to wetlands.



Photo 1: Food production on arable land in Bereg (upper) and Crișuri Plain (lower) (Photos by Katalin Petz and Elena Livia Minca)

In Romania, there is a better acknowledgement of the basic, local products and services, including raw materials, freshwater, cultural value compared to Hungary (Fig. 2). This is supported by the fact that in Hungary people utilize the local resources, such as berries, corn and wood less. Furthermore, the not palpable and abstract services – genetic resources, water purification, water regulation, natural hazard regulation, recreation and ecotourism and aesthetic value – are more recognized in Hungary than in Romania. The interviews and the observation show that the performance of the provisioning and cultural services matches their recognition by people. This means that when people are aware of the importance of a service, the service also performs better, e.g. food supply from arable land. In contrast, the performance of the regulating services does not

always correspond with their recognition. The performance of the regulating services is more dependent on the natural conditions than on the recognition. Consequently they are influenced directly by water and land management. For instance, even if natural hazard regulation is partly recognized by local experts, it has a low performance due to the structural water engineering measures.

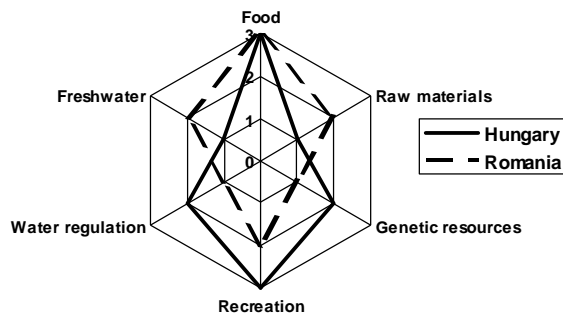


Figure 2. Recognition of services in Hungary and Romania: “basic” services (freshwater, food and raw material) and “abstract” services (water regulation, recreation and genetic resources)

Differences in water management between the two countries are reflected in the delivery of ecosystem services. In the Bereg Region the floodplain played an important role in the mitigation and retention of annual floods of the Tisza. After river regulation started 150 years ago the floodplain ecosystems were separated by dykes from the Tisza (Bellon 2004). This has led to the reduced capacity of ecosystem service provisioning. This is most obvious in the case of water regulation, natural hazard regulation and water purification services. The new water and land management plan aims at re-establishing the link between the river and the floodplain. The realization of the flood retention polder and the introduction of mosaic landscape management is designed to increase ecosystem services in the entire Hungarian study area (Molnár *et al.* 2007). For example, the polder would give space for the water retention and therefore for flood and drought mitigation. The regular water inundation of the flood retention polder would also enable wetlands to filter and purify the water.

In the Crişuri Plain the hilly natural characteristics reflected in lower intensity and frequency of floods. However, the inappropriate maintenance of water ways and canals hinders the performance of water regulation and water purification services (Photo 2). The water management plan aims to create bigger flood security and recreational opportunities by retaining

water in previously cut river arms. Despite the initial conceptual idea, the disconnection of these new wet areas from the surrounding ecosystems by dykes may hinder the fulfilment of the objectives. This would lead to a poorer performance of water related services.

In Hungary a broader awareness of ecosystem provided benefits was observed, particularly from the side of independent bodies (e.g. E-Misszió and Bokartisz NGOs) and related scientists. Although the term is not adopted in practice, local experts and mayors in the Bereg are acquainted with the meaning of ecosystem services. In Romania, the concept of ecosystem services is not known as such by any of the interviewees. The local people who work the land recognize some of the benefits they get from ecosystems. Among scientists and authorities there is understanding about the concept, but it has never been used, nor considered in their activities.



Photo 2: Poor water regulation in Bereg (upper) and Crişuri Plain (lower) (Photos by Katalin Petz and Elena Livia Minca)



## Discussion

This section focuses on the methodological difficulties and validity of the results.

Ecosystem services assessment in Hungary and Romania is pioneering work, since no similar studies have been conducted in these countries before. The biggest challenge of this research was establishing an appropriate assessment framework. First of all, the national research focuses mainly on mono-disciplinary studies matching for example the food provisioning or recreational services of ecosystems (e.g. Agro-21 Brochures in Hungary). Moreover, ecosystem services oriented research has not emerged in Hungary and Romania yet. Overall, there is no framework on assessing how ecosystem services are recognized by people and influenced by weather extremes.

The importance of this research lies – besides the scientific outcomes – in directly introducing stakeholders and local people to the integrated ecosystem approach in the interviews. Regarding the data analysis, broader knowledge was gained by combining theoretical deskwork and practical fieldwork. Since this combination is not a common practice in Hungary or in Romania, the present study is a good example of the benefits of joining theoretical and practical research.

Due to the limited time available for field visits and interviews (no inclusion of villagers), the evaluation of ecosystem services performance and recognition is necessarily based on personal interpretation and subjective. Yet the results of the assessment are very valuable in establishing the link between ecosystems, their services, human perception and water management plans. Overall, the outcomes can serve as a base for further ecosystem assessment and valuation studies in both countries as well as for the realization of ecosystems' value.

## Conclusions

As a conclusion it can be stated that in the current water management system, the natural capacity of ecosystems to fully provide their services is impaired, especially the water related ones. This is not only the effect of the human activity but also of the services' ignorance in planning and the consequence of wetland drainage and cutting river arms. Recently new water and land management initiatives – in particular in Hungary – aim to capitalize on the potential of ecosystems to regulate floods and droughts. To our best knowledge however, the concept of ecosystem services is not adopted yet in any of the countries. In Hungary, the

concept of benefits provided by the ecosystems was touched only by few scientists (e.g. economic valuation of the environment was applied by the Corvinus University of Budapest). In Romania no studies or institutions could be found using the concept of ecosystem services.

With respect to the ecosystem services delivery influenced by the new water and land management plans, bigger changes can be expected in the Hungarian case than in the Romanian one. The explanation resides in the larger extension of the Hungarian polder area – 75% of the study area is affected in Hungary, but only 5% in Romania – and the different character of the water management plans: the natural topography dictated water spread versus dyke surrounded wet areas. Overall, the ecosystem services have a lot of potential that can be capitalized upon through water and land management close to natural conditions.

## Acknowledgement

We are grateful for the opportunity of performing our research in the frame of the ADAM project. We are thankful to all the people who provided us useful information during the fieldwork, especially to Zsuzsanna Flachner, Attila Filep, István Asztalos, Tibor Esze, Károly Konecsny and János Mika in Hungary and Gavril Ujupan, Mihai Togor, Sabin Mușet, Vasile Crăciunescu, Roxana Bojariu and Vasile Ignățel in Romania.

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