The IDES Project – Improving water quality by integrative floodplain management based on ecosystem services

Extended Summary of the IDES Manual and the IDES Strategy

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Abstract

What contribution can floodplains along the Danube provide to water quality and how can their management take into account a wide range of interests across national borders? These questions were investigated by a European Union-funded consortium led by the Floodplain Institute Neuburg of the Catholic University of Eichstätt-Ingolstadt in the IDES project (Improving water quality in the Danube River and its tributaries by integrative floodplain management based on Ecosystem Services). The results of the project have been published in two main publications: The *IDES Manual* (Stäps et al. 2022) and the *IDES Strategy* (Vizi et al. 2022). While the *IDES Manual* presents the *IDES Tool* as a recommended method for the consistent valuation of ecosystem services (ES) in floodplains, the *IDES Strategy* describes the perspectives for the use of the *IDES Tool* in water management and spatial planning and for a better integration of the ecosystem services approach in legislation and programmes.

Introduction

The Danube River Basin covers more than 800,000 km^2 – 10% of continental Europe – and extends over the territory of 19 countries. Seven of these countries (Austria, Bulgaria, Germany, Hungary, Romania, Serbia, Slovenia) were partners in the project IDES.

Quality of human life depends on the functioning of ecosystems through the services they provide (provisioning, maintenance and regulation, and cultural). Healthy rivers and floodplains offer many of these ES and do so in large quantities. However, pressures from agriculture (changes in land use, excessive use of fertilisers and pesticides as well as soil degradation) and other sectors (energy, transport and tourism) have modified and degraded these ecosystems. As a result, human activities had direct negative impacts on these services.

Until now, these uses have been managed at a very sectoral level (e.g., water management, nature conservation, agriculture), mostly without consideration of water quality or interactions between sectors. At the same time, the Danube countries and governments have set themselves the goal of significantly reducing the nutrients transported by the Danube and thus improving the ecological status of the river. This challenge of reducing the eutrophication of the Danube and its tributaries, and thus the Black Sea, can only be met through transnational cooperation.

The ES-based River Ecosystem Service Index (RESI) already implemented in Germany (Pusch et al. 2018) has shown that water management can be significantly improved by identifying synergies between different ES reflecting diverse sectoral interests and objectives (Stammel et al. 2021). However, this concept has not yet been used in the Danube region to manage different activities in a proactive and holistic way.

The IDES project has developed, based on existing assessment methods, a transnational integrative ES approach, the *IDES Tool* for water quality improvement, which can be applied to floodplains throughout the Danube catchment. In the future, this approach should enable the main actors in the field of water quality management to identify particularly sustainable measures without neglecting the needs of other sectors.

The *IDES Manual* (Stäps et al. 2022) and the IDES Strategy (Vizi et al. 2022) present this approach in detail and outline its potential use in water management and spatial planning. These two project results can be downloaded from the IDES website (https://www.interreg-danube.eu/approved-projects/ides).

What are ecosystem services? ES are defined as the direct and indirect contributions of ecosystems to human well-being (TEEB 2010) and have an impact on our survival and quality of life. Currently, the standard in categorisation of the manifold ES at European level is the Common International Classification of ES (CICES, Haines-Young & Potschin 2018). Accordingly, ES can be divided into the following three main categories:

Provisioning ES: the ability of ecosystems to supply various material resources (e.g., timber production, drinking water and arable crop production)

Regulation and Maintenance ES: the capacity of ecosystems to affect and regulate natural processes (e.g., local climate regulation, nutrient retention, air purification, flood retention and sediment regulation)

Cultural ES: the capacity of ecosystems to provide aesthetic, recreational, historical, educational, or spiritual values (e.g., cultural and natural heritage, water-related activities [canoeing, swimming] and non-water related activities [birdwatching, cycling, hiking])

Figure 1. Location of the five pilot areas: 1) The Donau-Auen National Park, Austria; 2) Mura River, Slovenia; 3) Tisza River Floodplain near Szolnok, Hungary; 4) Koviljsko Petrovaradinski Rit Special Nature Reserve, Serbia; 5) Brăila Islands, Romania

At the same time, both documents have been summarised in brochures in seven different national languages of the Danube Region. Some extracts are presented below.

The IDES Tool

The *IDES Tool* has been developed to evaluate different management measures in river floodplains, such as dike relocation, land-use changes, dynamisation measures, with a holistic view of the needs of society. The different ES represent different interests and sectors. Their consistent assessment can lead to effective decision-making. At the same time, the objective valuation of ES can also promote communication between different stakeholders and raise awareness of the diversity of ES provided. The *IDES Tool* thus represents a methodological approach to standardise the valuation of ES in floodplains and to establish a clear link to water quality improvement. Although developed and implemented in the Danube River Basin, the concept is certainly transferable to other areas.

Five steps are required to value floodplain ES and water quality:

Step I: Delineation of floodplains and classification into river, active and former floodplain

Step II: Selection of ES relevant in the area out of a list 26 ES

Step III: Evaluation of ES for single floodplain segments (1 or 10 km wide) with a 5-level scale

Step IV: Prioritisation of areas with high potential for water quality functions

Step V: Visualisation of the results for status quo and scenarios

Implementation of the IDES tool in pilot areas

Five pilot areas (*fig. 1*) in Austria, Hungary, Romania, Serbia and Slovenia were selected to test, calibrate and improve the *IDES Tool* under different natural and socio-economic conditions. In addition to higher accuracy of data in the pilot areas, many stakeholders were involved in co-creating optimal scenarios to improve water quality in their areas. Several meetings and two workshops in each pilot area ensured that stakeholder perspectives were included in the early development of the tool. From the list of 26 ES, stakeholders individually selected and prioritised only those ES they considered important in their area. In the end, a common list of the ten most important ES was created and agreed upon. From a pre-defined list of 30 pressures, the stakeholders selected the pressures that have a (negative) impact on the ES present in the pilot areas. They selected and prioritised a list of five pressures. This step reflects the status quo, the state of the ES and the pressures in the pilot area. Possible actions were introduced in the co-creation process to identify scenarios to improve the state of the ES and ultimately the water quality in the area. Stakeholders discussed the most appropriate actions to reduce specific pressures and agreed on a list of five actions. Based on the Drivers-Pressures-State-Impact-Response (DPSIR) approach, the three elements: 'ecosystem services', 'pressures' and 'measures' and their interrelationships were the basis for a Fuzzy Cognitive Model (FCM) for each pilot area, reflecting the synergies and trade-offs between ES, pressures and measures. All relevant stakeholders in each pilot area co-developed and mapped such a model, showing their agreed perception of the status quo in their

area. By changing the intensity of the pressures, different scenarios were created: 'business as usual', 'ideal' (reduction of all pressures to a minimum) and 'optimal' (actions jointly agreed by stakeholders). In this way, stakeholders were able to see how pressures affect different ES and how the absence of one or all pressures will improve the status of the ES. The application of the *IDES Tool* in the Romanian pilot area 'Brăila Islands' is described in more detail below.

The selection of Ecosystem Services and Pressures at Brăila Islands, Romania

During a face-to-face workshop, 19 relevant stakeholders from local, regional and national authorities, research institutions and NGOs selected the Brăila Islands ES. The stakeholders identified the regulating and maintaining group of ES as the most important. The following five ES were selected: 1) habitat provision; 2) air pollution reduction; 3) local temperature regulation/cooling; 4) water purification/quality improvement; 5) flood risk regulation. Among the provisioning ES, stakeholders identified the following three ES as being of high importance in the pilot area: commercial fishing, drinking/water for animals and water for cooling or irrigation (domestic or industrial). Stakeholders identified two cultural ES as important for the area: contribution to research and education and opportunities for water-related activities (fishing, swimming and boating). They also identified the following pressures from different economic activities with negative impacts on ES: intensive fishing, solid waste (plastics, dredging waste), nutrient inputs, agricultural intensification and wastewater.

Matching the stakeholders view with ES mapping

The evaluation of the Brăila Islands pilot area with the IDES Tool (*fig. 2*) showed that the potential for flood risk regulation has decreased due to the conversion of natural land to agricultural land. Thus, the area now has a medium potential for flood risk regulation. In addition, the Big Island of Brăila has a very low potential for habitat provisioning, while the Small Island of Brăila has a high to very high potential. The Big Island of Brăila offers few cultural ES, but the presence of several Natura 2000 sites on the surrounding Danube arms increases its cultural ES potential to mostly high and very high.

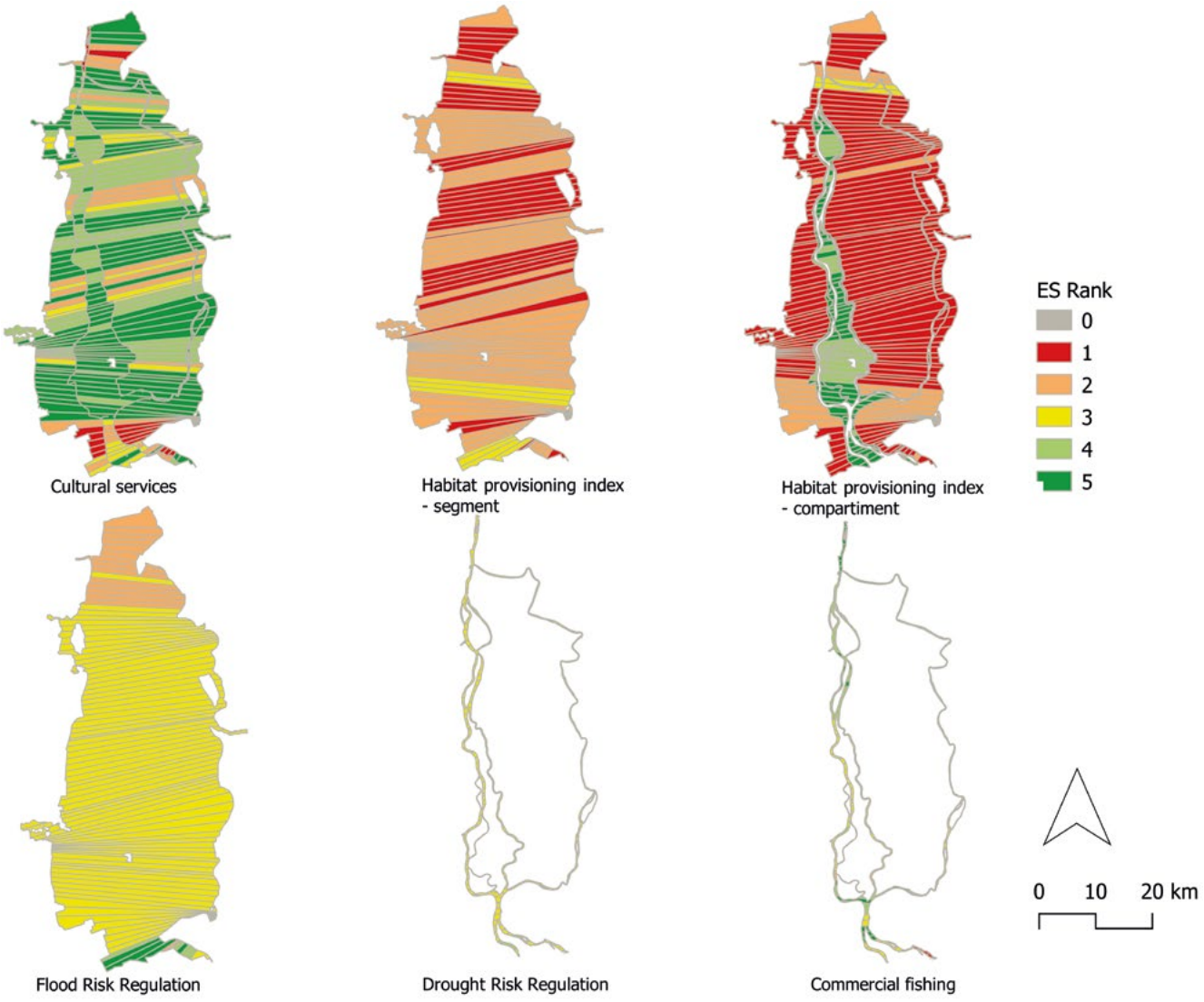

Figure 2. Selection of ES evaluated with the IDES Tool for Brăila Islands. The evaluation classes range from 0 (= no ES provision) to 5 (= very high ES provision)

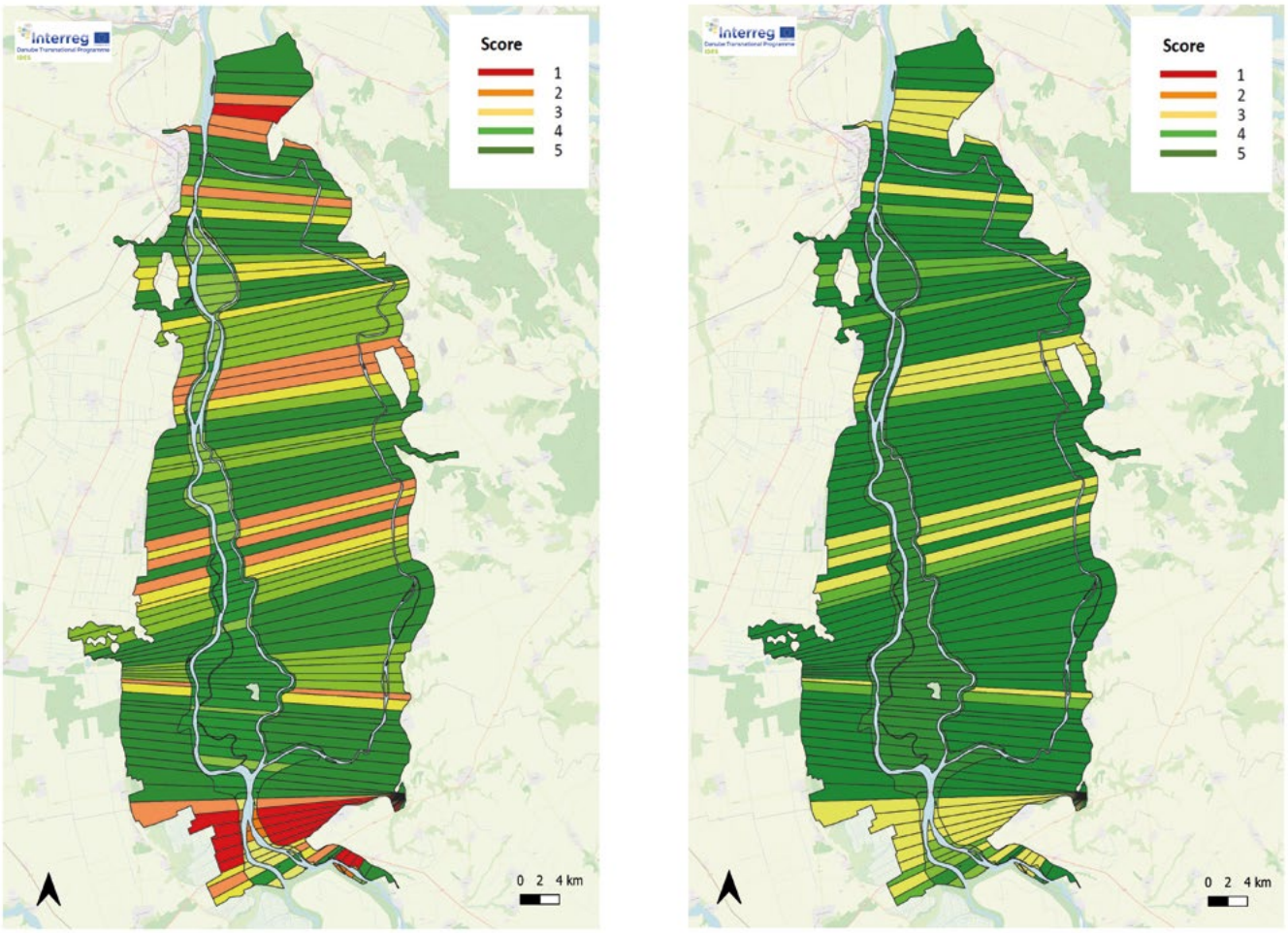

Figure 3. Status quo (left) and 'optimal' scenario (right) for the cultural services in Braila Islands.

The small island of Brăila has a very high potential to provide cultural ES. As a further consequence of the conversion to agricultural land, the Big Island of Brăila provides higher provisioning services to human communities. Even if the primary production of the small island of Brăila is constant, this service is not fully available to the human population but is rather consumed within the system. It maintains a high level of biodiversity and various ecological processes that allow other groups of ES to be maintained (e.g. regulating ES such as carbon sequestration, nutrient and sediment retention, flood regulation, and cultural and habitat provisioning).

Optimal scenario for the Brăila Islands pilot area

The local stakeholders agreed on and recommended a set of five measures as management options. Discussions on the optimal scenario for the Brăila Islands focused on reducing the use of nutrients, anticipating an increase in intensive agriculture in the near future. In order to make this scenario more concrete, additional tailor-made measures were proposed by the stakeholders: promotion/stimulation of nitrogen-fixing crops (soya, peas, beans, alfalfa), adapted crop rotation, cover crops to reduce the use of mineral fertilisers, use of organic fertilisers, bio-herbicides, permaculture, use of new technologies, improvement of curricula in universities and vocational schools, change of consumption habits. Stakeholders also agreed that simply complying with waste and wastewater legislation would reduce the impact on water quality. Given the current situation, upgrading existing wastewater treatment plants is also needed to improve water quality. By applying all the steps of the IDES Tool, it is possible to visualise the changes in the values of the ES between the 'status quo' and the 'optimal scenario' (*fig. 3*).

Conclusions from Brăila Islands pilot area

The use of pilot areas facilitated a better harmonisation of conflicting societal interests and led to the development of a conceptual framework (management options, ideas, values, visions) that was co-created with local stakeholders. The IDES project has shown that different communities in the Danube catchment, regardless of country, have the same understanding of ES, but the relative importance of ES varies from place to place. The level of importance of an ES is mostly considered based on the interest of the local communities. Thus, even if the pressures are the same throughout the Danube river basin, the specificity of the values that local communities place on ES is locally defined.

Recommendation for an ES-based integrative floodplain management

The improvement of the Danube's water quality in recent years has shown that it is possible to reverse (under certain

limits) the negative impacts of human activity. Nature-based solutions such as restoring a morphologically diverse river channel, reconnecting floodplains, or managing more sustainably areas adjacent to the water offer the opportunity to not only targeting a singular issue, (e.g. water quality), but also to look for solutions integrating several societal demands. Thus, these types of solutions aim at improving the ecological status of rivers and floodplains and at the same time enhancing services the ecosystem provides for human well-being. In this regard, the IDES Tool has shown in the pilot areas that the functional approach of ES assessment facilitates integrating the various interests in a multidimensional view. This enables stakeholders to better understand and appreciate the perception of others, and to jointly develop site-specific integrative concepts. Availability of a new, common assessment procedure, as it is the IDES Tool that takes almost all relevant ES into account, is favouring incorporating the ES concept into spatial and socio-economic planning and decision-making. The IDES approach harmonised between the Danube river basin countries will enable water managers and planers of different levels designing ES based, integrative and transparent decision-making processes. This will foster the application of the ES approach and result in multipurpose and sustainable solutions. At the local and regional levels, where water management projects are realised, the detailed assessment of ES based on the available local data may help to convince land users and land owners as well as all relevant stakeholders to apply measures in order to increase the ES availability in their floodplain territories. Chances for a successful implementation of restoration projects increase when stakeholders and their ideas and perceptions are integrated into the planning process. At the national or basin-wide level the assessment of ES and the multifunctionality of floodplains will serve more the conceptual and strategic planning, by identifying potentials and deficits and comparing scenarios. The IDES Tool may be effectively implemented to adapt river-floodplain systems that formerly had been modified to maximise one or a few societal benefits to the more sustainable and more diverse societal requests and legal requirements of the 21st century. For that purpose, we recommend here to implement the IDES Tool also at Danube-wide and national levels in addition to the positive experiences at local level.

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Aboveground biomass and carbon stock of the riparian vegetation in the Danube Delta

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Abstract

Intact wetlands can act as carbon sinks and mitigate increased amounts of greenhouse gases in the atmosphere following climate change. In addition to organic soils, the riparian vegetation plays an important role in carbon storage and cycling within wetlands.

In the context of the project 'EDAPHIC-BLOOM Danube', the riparian vegetation in the Danube Delta was investigated. Preliminary results show differences in aboveground biomass and carbon content between softwood and hardwood riparian forests and artificial poplar plantations. The aboveground biomass in the reed beds is much lower per plot, but due to their huge extension, they are very important for carbon storage.

Introduction

In terms of climate change, the mitigation of greenhouse gas (GHG) emissions is very important. Hereby, carbon dioxide is considered the most important GHG among anthropogenic emissions. Ecologically intact wetlands and floodplains can act as carbon sinks and mitigate increased amounts of carbon dioxide in the atmosphere following climate change (Cierjacks et al. 2010). In addition to the organic soils (Wilson et al. 2016) for example in reed beds, floodplain forests play an important role in the carbon storage within wetlands.