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CASE STUDY

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Integrating scenario based learning and design thinking to strengthen climate resilience in landscape architecture education

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Abstract

In the context of accelerating climate change, design thinking and robust scenario planning are crucial abilities for landscape architects. The case study presented aims at scenario-based learning for landscape architecture students who will face the task of rigorously evaluating their designs for resilience and effectiveness against future climatic challenges. To equip future landscape architects with the skills necessary to navigate these complex challenges, this study utilized a case study of the Přítlucký polder a significant flood protection area in Czech Republic projected to face increased flood events due to climate change. Climate models based on RCP 8.5 forecast a future defined by hydrological extremes for this region, including flash floods and very wet winters, alongside severe summer droughts and over 40 annual days of heatwaves by the end of 21st century. This area, which serves to reduce flood risk for surrounding settlements is also notable for its inclusion in a UNESCO Cultural Heritage site and a newly established Protected Landscape Area, providing an ideal context for training students in the integration of nature and cultural landscape protection with flood risk management. The project involved four international student teams using a three-phase methodology: preparatory research, an intensive on-site workshop, and the development of full-scale scenarios evaluated through Ecosystem Services (ES) assessment. The study yielded four distinct resilience strategies based on rigorous spatial analysis. Findings indicate that students successfully applied systems thinking to quantify trade-offs. The results demonstrate that scenario-based learning combined with ES assessment enables students to move beyond conceptual design and producing actionable strategies.

1 Introduction

Landscape architecture, as an independent discipline, inherently crosses the boundaries of a single field. Historically, it has employed tools such as working with terrain, vegetation, water elements, and structures – each of which represents a specialized profession in its own right. No single designer can fully master all of them, which is why interdisciplinary teamwork is an essential skill for landscape architects.

Beyond its professional complexity, landscape architecture has also evolved in conceptual and planning directions. Already in the 1960s, Ian McHarg [1] introduced the idea of landscape planning based on ecological principles. This approach, applied particularly at a large scale, is founded on the assumption that different types of landscapes are suitable (or unsuitable) for different types of uses.

After 2000, Carl Steinitz [2] expanded on this line of thought with the concept of geodesign, which proposes land use at a broad scale through scenarios of future development. Working with scenarios is a key tool here, as it enables the simulation of alternative options and comparison of their impacts [3]. Geodesign is a conceptual process that involves many variables – and therefore requires systems thinking and design thinking, the ability to creatively and iteratively address complex problems [4, 5]. Systems thinking is an approach focused on relationships between elements within a system, rather than on isolated parts. It enables us to understand complex issues that cannot be solved linearly or simply. If landscape architecture aspires to go beyond the design of gardens, parks, and public spaces toward broader-scale planning and climate change adaptation [6], it is essential to embed systems thinking and design thinking into the curriculum of landscape architecture education [7].

In this regard, ecosystem services (ES) and their assessment play an important role – they represent a tool that integrates natural, cultural [8], and economic aspects into a single framework [9]. Ecosystem services are classified according to the international TEEB (The Economics of Ecosystems and Biodiversity) framework [10]. This approach makes it possible to map and assess individual ES, synergies and trade-offs the impacts of specific measures on the wider territory or to compare different development scenarios [11]. Understanding the relationships among multiple services and the underlying mechanism [12, 13], however, requires professional training and practical experience, and thus represents a significant educational challenge as for designers and for the policy makers [14].

Closely related is the interdisciplinary approach [15], which is a key part of the educational process. Each discipline – whether hydrology, landscape architecture, nature conservation, or heritage protection – uses different methods and working procedures. For students, it is essential not only to understand these differences, but also to overcome barriers to cross-disciplinary communication and to acquire the ability to collaborate. This skill is crucial for their future professional practice.

Design with nature, geodesign, ecosystem services assessment - all these methods attempt to develop sustainable and future-proof solutions that take into account the existing natural conditions of the location, social and economic requirements, and the specific needs of users. This makes it clear that, on the one hand, different approaches already exist and, on the other hand, there is a need to further develop the training of prospective landscape architects in order to meet the current complex requirements. This raises the question of how this can be achieved in the future.

For this reason, we selected an area whose character allows the integration of multiple disciplines while clearly demonstrating the impact of climate change on the landscape. The manifestations of climate change – in particular, extremes caused by both the shortage and excess of precipitation, namely droughts and floods – form the context of the case study. The site represents a model example of climate change effects in Central Europe, with significance that goes beyond the local level. It is linked to a UNESCO

World Heritage site, where there is a broad social consensus to not only preserve but also sensitively develop the landscape.

In order to meet these requirements and provide a range of specialist expertise and perspectives to tackle the task, students from five universities and experts from various disciplines (landscape planning, hydrology, Geographic Information Systems (GIS), etc.) were involved. At the same time, the study area provides a blueprint for many other areas in Europe.

The aim of this study is to test and evaluate a student-centered, scenario-based workshop in a flood-prone and culturally significant area, integrating interdisciplinary collaboration, the use of ecosystem services, and climate change adaptation.

2 Study area and context

The case study area is located in Central Europe, in the Czech Republic near the Austrian and Slovak borders. It functions as a polder on the Dyje River, serving as a critical flood protection zone that is expected to experience more frequent flood events under future climate change on one hand and extensive droughts on the other hand (Fig. 1). Alongside its strategic role, the area holds significant natural and cultural values, making it an ideal model site for engaging stakeholders from multiple disciplines.

The entire site lies within the Dyje River floodplain and has a long and dynamic history. Historically, this landscape was dominated by extensive floodplain forests and wet meadows, as documented in 18th- and 19th-century maps. Only limited areas, where conditions permitted, were cultivated for crops, and these represented a marginal share of the territory.

A major transformation occurred in the second half of the 20th century with the construction of the Nové Mlýny reservoirs upstream from the study area. Built between

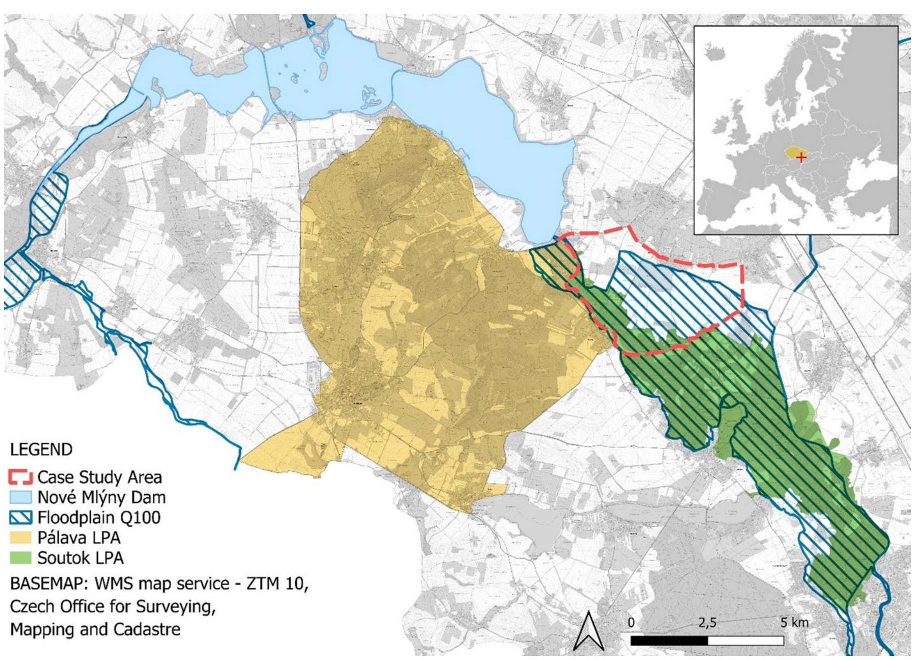

Fig. 1 Location of the Case Study Area in the Czech Republic. The case study area is highlighted by a dashed line. The figure indicates the position of the case study area within the water management system, depicting the Nové Mlýny Dam and defining the inundation areas for Q100 flood levels. It also shows the position between Landscape Protected Areas (LPA)

1975 and 1988 under the authoritarian regime in former Czechoslovak Republic, the three interconnected reservoirs were designed for flood control, irrigation, and recreation [16]. However, their creation inundated large expanses of natural floodplain forests, wetlands, and meadows, while also drying out areas downstream [17, 18]. The ecosystem shifted from a dynamic floodplain forest to irrigation-dependent forests [19] and cropland with only scattered remnants of floodplain woodland [20]. As a result, regional biodiversity declined sharply, with many rare and specialized species – particularly floodplain forest flora, amphibians, and wetland birds – losing their natural habitats [20].

Since the early 2000s, restoration efforts have been underway [21], culminating in the 2025 designation of the Soutok Protected Landscape Area [22], which extends to the southern boundary of the site. Its aim is to conserve the unique cultural landscape of floodplain forests, alluvial meadows, and oxbow lakes [22]. It complements the adjacent Pálava Protected Landscape Area to the west, which protects limestone cliffs and drought-adapted ecosystems.

Culturally, the region is rich in heritage values. Just to the south lies the Lednice–Valtice Cultural Landscape, inscribed as a UNESCO World Heritage Site in 1996 [23]. Developed by the Liechtenstein family between the 17th and 20th centuries, it is renowned for its harmonious integration of chateaux, landscaped parks, romantic follies, and long tree-lined avenues. This landscape reflects the historical vision of a cultivated aristocratic countryside where architecture and nature are closely intertwined [24, 25].

The local economy focuses on small-scale viticulture and tourism. Two major visitor attractions are the Pálava Protected Landscape Area to the west and the Lednice–Valtice Cultural Landscape to the south. In 2024, Lednice Castle was the most visited tourist attraction in the Czech Republic, with over 300,000 visitors [26]. The area is well connected by marked hiking and cycling trails, and the tourist season extends from spring until late autumn, supported by wine production.

The entire region is vulnerable to the impacts of climate change [27]. Projections based on the IPCC Representative Concentration Pathways (RCPs) indicate that under RCP 4.5, average temperatures could rise by +2 to +3 °C, with slightly wetter winters, drier summers, and increased summer drought stress. RCP 6.0 projects a warming of +3 to +4 °C, with wetter winters, more severe summer droughts, heightened drought-related stress, and greater risks from forest pests. Under RCP 8.5, warming could reach +4 to +6 °C, leading to pronounced seasonal shifts, very wet winters, severe summer droughts, over 40 annual days of heatwaves, flash floods, prolonged dry periods, substantial biodiversity loss, and major impacts on agriculture, water availability, public health, and energy demand.

Future management of the Dyje River polder will require balancing its essential role in flood protection with the conservation of its outstanding cultural heritage and biodiversity.

3 Methodology

Based on the selected study area, students from different universities with varying levels of education were asked to develop solutions for climate adaptation strategies and measures using a scenario-based approach. To meet this requirement, a structured process with different teaching methods was chosen (see Fig. 2), based in part on geodesign [2]. In order to assess the achievement of objectives, intensive discussion and feedback rounds were held during the attendance phase to ensure that the results met the requirements of the study area and to review the students' learning outcomes. To ensure that the ES approach [28] could be used in the short time available and that the measures could be assessed, comprehensive evaluations of four selected ES were carried out in advance and made available to the students. The individual methodological steps are briefly explained below.

3.1 Educational setup

The educational setup involved collaboration among six universities from five Central European countries — the Czech Republic, Slovakia, Germany, Austria, and Poland. All participating institutions were universities of life sciences with programs in landscape architecture and landscape planning, placing strong emphasis on understanding natural processes. This approach differs from that of technical universities, which tend to focus more on engineering and technological solutions. No extraordinary admission requirements were imposed on participating students; however, they were required to be in at least their second year of study and to have a minimum English proficiency level of B2. The selected participants included both bachelor's and master's students.

Lecturers were invited based on their expertise in teaching design studios in landscape architecture and landscape conservation, as well as in landscape engineering, participatory planning, GIS, and hydrology.

The entire process was structured into three stages: a preparatory online phase, an intensive on-site workshop, and a completion phase. Each stage had slightly different learning objectives, accompanied by a corresponding teaching method (Fig. 2).

3.2 Preparatory phase

To bring the case study as close to real-world practice as possible, the work was based on actual technical and strategic planning documents. The volume of information required for a comprehensive understanding – particularly given the foreign context, language, and planning customs – could not realistically be processed within a single one-week workshop.

Therefore, the preparatory phase focused on assembling and translating essential background materials into English. This included:

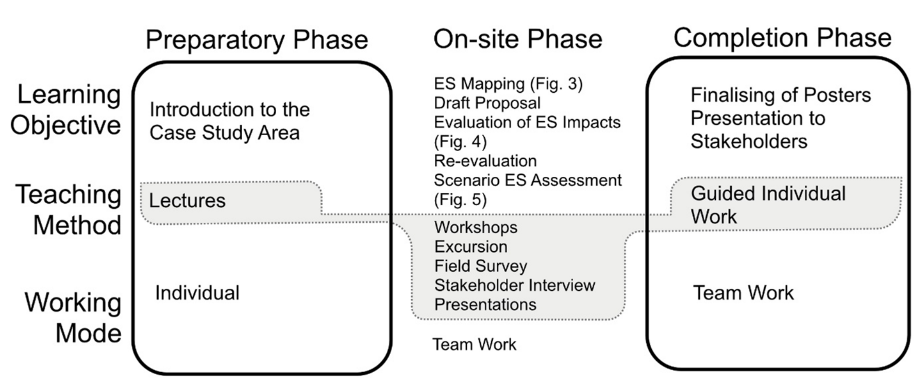

Fig. 2 Educational process diagram. The intensive phase corresponds to on-site phase

- An introductory presentation of the study area.
- Relevant strategic documents and spatial planning data.
- Ground-level and UAV photographic documentation providing an overview of the site, freely available for student use.
- Spatial datasets suitable for GIS analysis, including raster data (DEM, DSM) and vector layers with land use, property boundaries, flood extent zones, and protection zones.

An online Introduction Meeting was held to present the site context and to introduce the methodology for ecosystem services assessment using GIS tools.

Moreover, during this preparatory stage, students were tasked with:

- Reviewing the provided materials thoroughly to familiarize themselves with the area.
- Conducting a brief review of a similar site in their home country where revitalization measures had been implemented in the catchment of a medium-sized river.

The aim was to immerse students in the topic and mentally prepare them for the intensive design week.

3.3 Design of the intensive on-site phase

For the intensive on-site phase for one week, participants were organized into international teams composed as to ensure diversity in both university affiliation and study level. The intention was to develop skills for working in international teams while facilitating peer-to-peer knowledge transfer between more experienced and less experienced students. Each team was assigned a pair of lecturers, who provided consultation, guided the professional direction of the work, resolved communication challenges, and monitored team dynamics.

The program was structured into four thematic components:

- Field trip and excursions – Essential for understanding the site context. The excursions included guided tours by a water management expert from the Dyje River Basin Authority, who presented the water regime and floodplain revitalization plans. Independent site visits allowed students to document current land use and assess potential for change.
- Thematic lectures – Covering key case study topics such as hydrology and flood protection with a focus on river revitalization options, cultural landscapes and design in historical contexts, and methodologies for ecosystem services assessment, including a dedicated GIS-based analysis block.
- Independent teamwork – Scheduled primarily in the afternoons, with increasing time allocation towards the end of the week as project work approached completion.
- Wrap-up presentations – Daily short presentations in which teams shared their interim results. The learning objective was to consolidate daily progress, clarify tasks, and close the day with a clear plan for the next steps.

3.4 Analysis and scenario development

At the outset of the assignment, students were provided with a concise methodological guideline comprising five sequential steps:

1. Territorial analysis aimed at understanding the functioning of the area in terms of natural processes, artificial hydrological regimes, agriculture, nature conservation, cultural landscape and socio-economic characteristics.
2. Identification of potential threats and opportunities arising from climate change (particularly droughts and floods), intensive agricultural practices, recreational development, and the restoration of natural habitats.
3. Assessment of current land use in relation to identified threats and opportunities, including the delineation of conflict areas where either threats prevail or development potential is constrained.
4. Development of a scenario, including a vision and concrete implementation measures for sustainable development in the study area.
5. Assessment of the measures and the overall scenario using the ecosystem services approach.

In the case of this study, the stakeholders were representatives of the Waterboard (Morava River Basin Authority) and the Lower Morava Biosphere Reserve. The presence of stakeholders was crucial, as it offered students insight into the local area's functioning and a perspective on the studies and intentions developed by the Morava River Basin Authority for the territory. Most importantly, they provided a study defining future water supply to the area and the technologies for its accessibility. A joint on-site survey was also included. Another stakeholder was the Lower Morava Biosphere Reserve, whose activities focus on coordinating environmental initiatives. Their lecture provided further insight into the site's issues and assisted in the problem definition phase. The representatives also helped evaluate the students' work and promoted the results to the public (e.g. on The Day of Protected Area Soutok [29]).

3.5 Evaluation method

Landscapes and structures produce multiple ecosystem services e.g. climate regulation, food production or recreation. Some sets are called bundles appear together in time and space [11, 12, 17, 20, 30]. Sometimes the maximization of one ecosystem service or bundle results in declines of other ecosystem services. For this reason, a fundamental understanding of the interdependencies is necessary in order not only to optimize individual ecosystem services, but also to identify the influence on all ecosystem services examined in order to determine multifunctional optimizations. To this end, four ecosystem services relevant to the study area were selected:

- flood protection,
- food production,
- recreation and tourism, and.
- biodiversity.

These four ecosystem services were individually recorded and evaluated using an assessment matrix [1, 17, 31] (Fig. 3). In a second step, the measures developed were assessed in terms of their impact on the respective ES. To this end, it was examined whether they had a positive, negative, or no impact. Subsequently, it was possible to determine how individual measures affected the ecosystem services examined (multifunctionality) and the overall impact of the scenario developed (Fig. 4).

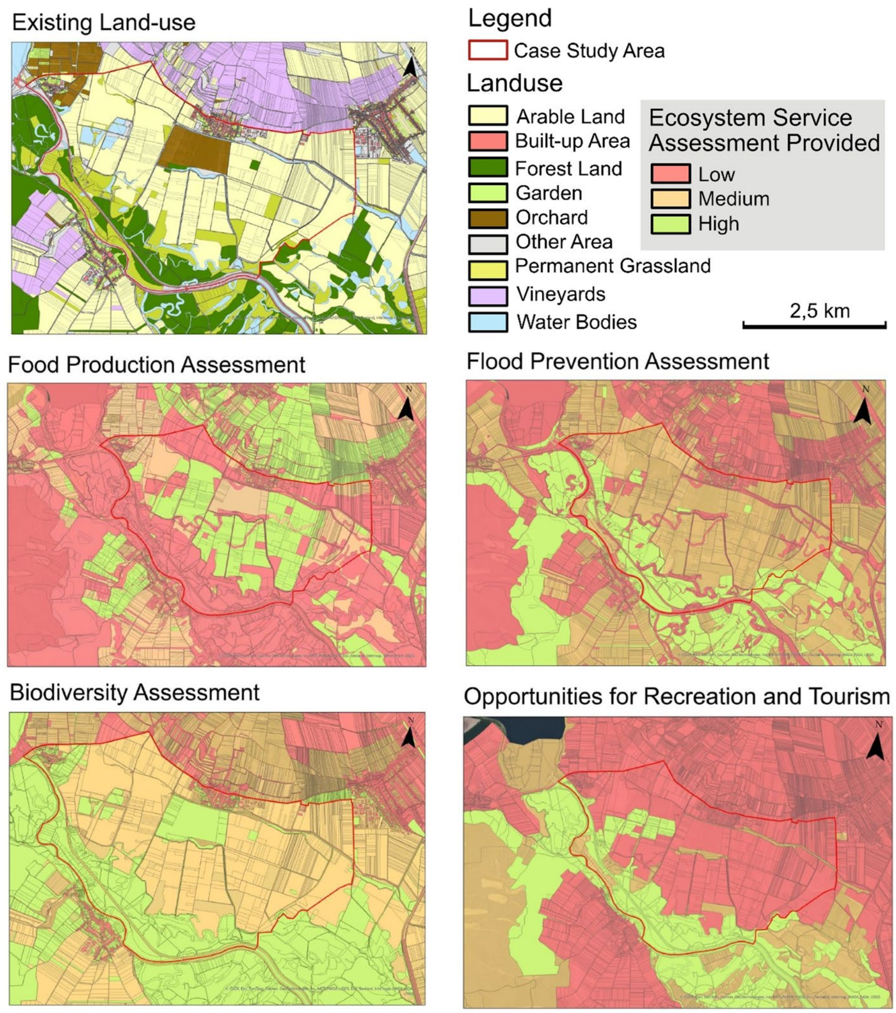

Fig. 3 The figure displays the mapping of streamlined ecosystem services within the territory based on existing land use. Individual maps show the services provided on a relative scale of Low, Medium, and High for each ecosystem service. (Authors: Jidapha Jotidilok, Vanshika Mahajan, Veronika Murgašová, Weronika Kamińska, Zuzana Andiľová)

3.6 Review of the methodological approach's achievement of objectives

In order to examine the extent to which the concept used contributes to raising students' awareness of climate resilience and developing suitable solutions through scenario-based learning and design thinking, regular discussions were held during the on-site phase. On this basis, and following evaluation of the interim presentations, the team of supervisors regularly engaged in critical reflection on any adjustments that might be necessary to the schedule for the coming days. Finally, an evaluation was carried out by the participants after the presentation of the results. This made it possible to assess the extent to which the learning objectives had been achieved. This enabled the supervisors from the respective universities to assess the extent to which the concept used could be integrated into existing teaching concepts and how this could be achieved in the future under the respective specific conditions.

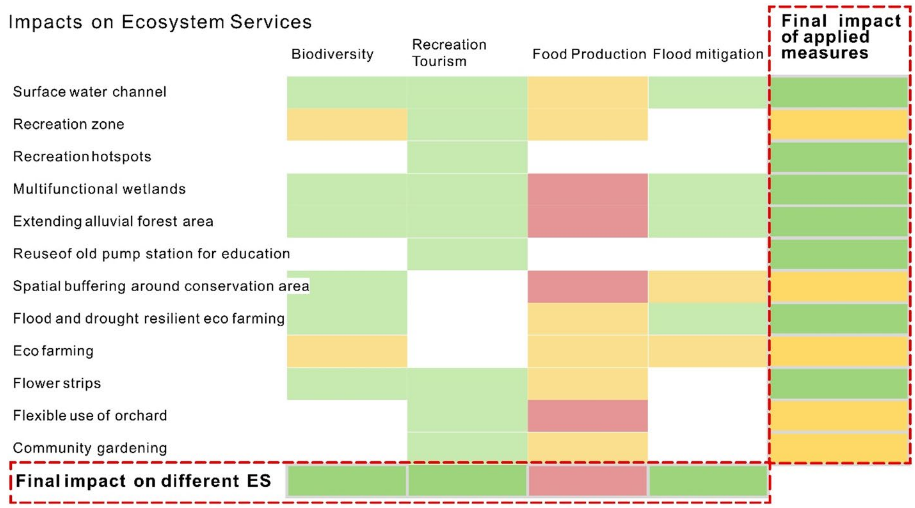

Fig. 4 The ecosystem services matrix illustrates individual measures and their overall impact (green = positive, yellow = neutral/no impact, red = negative impact). The assessment results in a negative, neutral, or positive impact on ecosystem services. This simplified assessment scheme helps students comprehend complex systems and facilitates structured systems thinking. (Authors: Anna Huber, Michal Hracho, Laura Motykova, Latiful Kabir Sujon, Agata, Wrona)

4 Results

Based on the field trips and intensive discussions within and between the teams, the students delivered impressive results.

Team 1, "Eco-nexus," proposes six measures for the Pritlucky Polder to create a resilient, balanced landscape by building on its ecological, cultural, and economic assets. Designed for a 5–10-year timeframe, with some actions implementable immediately, the plan focuses on enhancing ecosystem services. Measures include:

- expanding biodiversity hotspots through habitat restoration and wildlife corridors;
- converting alluvial grasslands into meadows as buffers between forests and farmland with horse grazing for soil health;
- improving connectivity by modifying private fences for small animal passage;
- promoting agricultural tourism via guided visits and photo zones;
- restoring former mining sites into grasslands or meadows with limited recreational fishing;
- and adding interpretive viewpoints that celebrate local scenery and oak trees as defining landscape elements.

Team 2, *"Balancing by Reconnecting,"* proposes a multifunctional landscape for the Pritlucky Polder that harmonises biodiversity, agriculture, and recreation through restored water dynamics and stronger links between people, nature, and culture. The plan addresses degraded gravel pits, underused water bodies, fencing, and poor infrastructure while seizing opportunities to expand forests, meadows, wetlands, and wildlife corridors. Measures include:

- creating a new water channel, wetlands, and alluvial forests.
- introducing 20 m buffer zones;
- promoting flood- and drought-resilient eco-farming;
- converting uplands to flower strips and community gardens;

- and enhancing recreation via trails, viewpoints, and an educational hub.

Benefits include greater biodiversity, improved flood mitigation, and sustainable long-term agriculture supported by pollinators, water security, and healthy soils.

Team 3, *"POLDER: NEXT GENERATION,"* proposes a multifunctional, inclusive, and resilient landscape for the Pritlucky Polder, stressing closeness to adjacent to the Lednice–Valtice Cultural Landscape. The design integrates:

- pocket forests, seasonal water channels, and buffer zones to manage flooding,
- connecting of habitats, and enrichment of the ecological and recreational value.

Accessibility is improved via walkable trails, sensory features, and "Easy Access" infrastructure for diverse user groups. Viewpoints and fence removal open vistas and strengthen connections, creating a landscape that serves both present needs and future generations.

Team 4, *"The Living Polder,"* envisions rewilding water, restoring life, and renewing land in the Pritlucky Polder by enhancing its natural functions while addressing challenges such as land disturbed by mining, sparse vegetation, polluted artificial lakes, and obstructive fencing. The proposal strengthens five key landscape functions:

- improving flood control and groundwater retention through water remediation;
- boosting biodiversity and habitat connectivity as part of the Dyje floodplain and Natura 2000 network;
- using seasonal meadows and pastures for flood-enriched agriculture;
- preserving the cultural and aesthetic legacy of the Lednice–Valtice landscape; and expanding recreation and education through trails, birdwatching, eco-tourism, and adaptive reuse of former mining areas.

The result is a multifunctional landscape that builds on the polder's inherent potential while mitigating environmental and visual degradation.

All teams assessed their scenarios and individual measures in terms of their impact on the ecosystem services investigated. This enables prioritization during implementation, taking into account the respective impacts (Fig. 5).

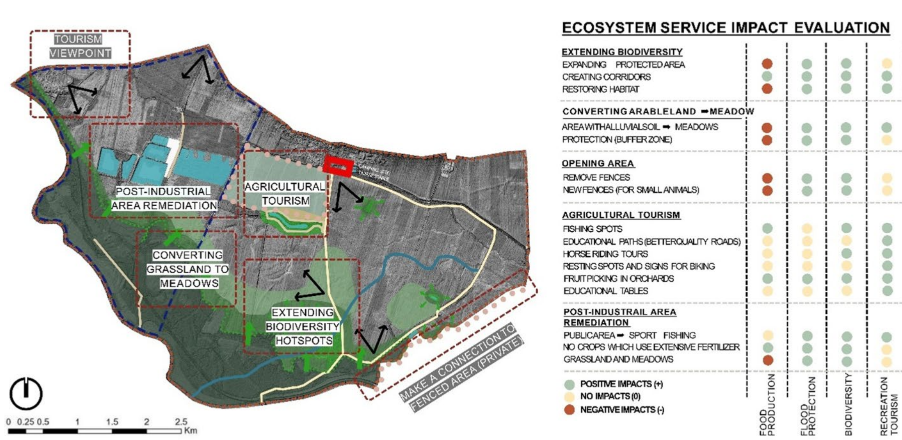

Fig. 5 The scenario (Team 1) and its impact evaluation on ecosystem services. In this context, a scenario represents the design proposal of a single team. Within each scenario, measures are proposed that result in land-use changes and impact ecosystem services. Individual measures are evaluated in the right-hand column. (Authors: Jidapha Jotidilok, Vanshika Mahajan, Veronika Murgašová, Weronika Kamińska, Zuzana Andiľová)

Table 1 Summary of measures and the solutions developed

Biodiversity and Habitat Connectivity	
Team 1	Expanding biodiversity hotspots via habitat restoration and wildlife corridors.
Team 2	Extending forests, meadows, wetlands, and improving wildlife corridors.
Team 3	Pocket forests, habitat connections via buffer zones and seasonal water channels.
Team 4	Boosting biodiversity and habitat connectivity in the Dyje floodplain and Natura 2000 network.
Integration of Agriculture with Ecology	
Team 1	Converting alluvial grasslands into meadows with horse grazing; agricultural tourism promoting local farming heritage.
Team 2	Flood- and drought-resilient eco-farming; flexible use of orchards; conversion of uplands to flower strips and community gardens
Team 3	Using floodwater for irrigation and adding landscape structures to farmland
Team 4	Seasonal meadows/pastures benefiting from natural flood fertilisation.
Recreation and Education	
Team 1	Interpretive viewpoints; guided crop/fruit collection; photo zones.
Team 2	Strategic recreational zone; forest viewpoints; educational hub from fishermen's hut.
Team 3	Walkable trails, sensory elements, "Easy Access" design; open viewpoints.
Team 4	Trails for cycling and hiking; birdwatching; eco-tourism; environmental education and research; adaptive reuse of former mining areas.
Addressing Physical Barriers	
Team 1	Modifying private fences to allow small animal passage.
Team 2	Addressing obstructive fencing as part of connectivity improvements.
Team 3	Fence removal to improve views and access.
Team 4	Removing or addressing disruptive metal fences to improve connectivity and aesthetics.
Response to Water Management Issues	
Team 1	Using meadows and grasslands as flood buffers.
Team 2	New water channel; multifunctional wetlands; alluvial forest expansion; 20 m buffer zones
Team 3	Seasonal water channels; buffer zones; connecting water bodies; regular artificial floods.
Team 4	Improving flood control; water retention; groundwater stabilisation; remediation of polluted water bodies.

There are clear similarities in the teams' perceptions of landscape values, problems, and proposed solutions (see Table 1). Five main patterns emerge: Biodiversity and Habitat Connectivity, Response to Water Management Issues, Integration of Agriculture with Ecology, Recreation and Education, and Addressing Physical Barriers. It should be noted that these topics serve as the main frameworks. Each topic differs among the teams in the measures proposed, as well as in spatial configuration and extent, which should be considered as original contributions. At the same time, the approach centred around ecosystem services made it possible to convey an understanding of the interrelationships between individual and multiple functions. Systems-oriented thinking and sensitivity to the potential and conditions of the location could thus be implemented in the design process.

Looking at the results achieved, it is clear that the students succeeded in developing solutions based on the data and information provided as well as the strengths and weaknesses identified in the field. At the same time, they were able to develop viable scenarios and carry out an appropriate impact analysis. The concept developed and implemented was assessed by the teachers as a suitable teaching method. Discussions among the teachers and with the students made it clear that the expected goals had been fully achieved. This ensures that the approach can be implemented in the training of landscape architects. In addition, a scalable concept is now available that can be adapted to other issues and transferred to other areas of investigation.

5 Discussion

The principle of multifunctionality may serve as a valuable framework in design assignments, bridging the scales of landscape and regional planning. Recognizing the multiple functions of landscape components should be a core competence for landscape architects, not only when this knowledge enables diverse uses, but also when it informs the management of trade-offs. Assessment of ecosystem services represents one effective method for cultivating this awareness among students [32, 33]. However, in educational exercises, the evaluation of ecosystem services often involves a balance between methodological rigor and pedagogical simplicity. While simplification can make complex systems more accessible, it also risks overlooking important nuances. Moreover, an exclusive focus on ecosystem services may overshadow other critical criteria, such as social justice, governance capacity, or issues of private ownership [34]. Conversely, the way trade-offs and synergies among different ecosystem service categories are addressed can profoundly shape participants' understanding of integrated landscape management, emphasizing the importance of carefully framing these discussions within the learning context.

Another consideration is the emphasis on interdisciplinarity, which, while enriching the design process, can potentially compromise design quality when time for development is limited. This tension should be acknowledged and addressed in the planning of workshops and similar educational formats.

Short-term workshops, offer opportunities for intensive, scenario-based exploration. These formats can foster systems thinking, yet the inherent complexity of landscape processes raises questions about the depth of understanding achievable within such a constrained timeframe. Scenarios may remain primarily conceptual, lacking clear pathways toward implementation. At the same time, the tight schedule of these workshops can create tension between encouraging creative ideas and achieving analytical depth, affecting both the scope and rigor of outcomes. Nevertheless, such workshops hold considerable potential for introducing systems thinking into the landscape architecture curriculum.

Unfortunately, the ecosystem services assessment was limited to the four selected services. Even though this meant that not all services and interactions could be presented and assessed, it was possible to show examples of how planned measures would affect each individual ES. It was also possible to determine the influence of the ES on each other and to present the overall effect on the respective ES. When making the selection, an attempt was made to choose significant ES in order to represent the functions of the polder. Taking other ES into account would have led to a more in-depth analysis of the effects and interactions and, if necessary, to further measures. In particular, consideration of CO2 storage capacity could have led to further solutions [35].

However, this would have further increased the complexity. Given the limited processing time, there was a risk that the learning effect for the students would be impaired and the development of scenarios and concrete measures would be negatively influenced. Even with the small number of ES, it was possible to illustrate the systemic approach. Similar to geodesign, this makes it possible to take the essential aspects into account in a structured manner when finding solutions [36]. A further addition would be possible in the planning process and would possibly lead to further measures or adjustments to measures.

Educational setups aim to simulate real-world planning conditions but inevitably struggle to capture the full complexity of bureaucratic constraints, conflicts of interest, and economic feasibility. While students often generate idealized solutions, these may diverge significantly from what is politically or economically implementable. This contrast highlights the challenge of aligning learning outcomes with the realities of professional practice and underscores the need for educational experiences that prepare students for practical decision-making and negotiation processes. Geodesign, with its integrated participation and discussion process, offers opportunities to reflect reality more clearly [2]. During the face-to-face phase, attempts were made to take this into account by involving selected stakeholders. However, this could be integrated even more strongly in the future.

6 Conclusion

This study demonstrated the value of scenario-based, interdisciplinary education in landscape architecture. By engaging students from different cultural and professional backgrounds in a real-world context, the workshop fostered not only technical skills in GIS and ecosystem services assessment but also collaboration, creativity, and systems thinking. The resulting proposals illustrate the potential of student-centred learning to address pressing challenges of climate change adaptation in multifunctional landscapes. The process benefited from a combination of several approaches, namely: on-site visits, a multi-disciplinary team of lecturers, a streamlined methodology, a specific and condensed timeframe, and final wrap-ups. The authors collective considers the greatest contribution to be the fact that the teams managed to maintain systems thinking throughout the entire design proposal process. This included the initial assessment phase (Fig. 3), the combination and evaluation of individual impacts (Fig. 4), and the assessment of the final design (Fig. 5; Table 1). In this way, the students succeeded in evaluating individual measures (Table 1) through a step-by-step approach, determining their contribution within a coherent overall process.

At the same time, the exercise revealed important limitations: the short time frame encouraged conceptual solutions rather than implementable strategies, and the use of ecosystem services as an evaluation tool, while useful, only partially captured the cultural and heritage values of the study area. Nevertheless, the workshop provided a safe testing ground for students to navigate trade-offs between flood protection, agriculture, biodiversity, and recreation — a skill that is highly relevant to future practice.

Ultimately, this educational experiment underscores the importance of embedding interdisciplinary collaboration and scenario-based learning into the curriculum of landscape architecture. Beyond the academic setting, such approaches could inform participatory processes and support policy development in regions facing similar challenges.

Preparing future professionals to work creatively and systemically is not only an educational goal but also a societal necessity in the era of climate change.

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Data availability
The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval
Not Applicable.

Consent to Participate
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