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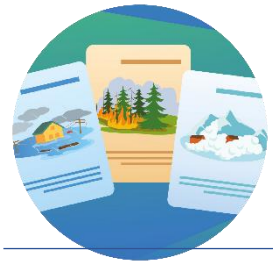

EUSALP ACTION GROUP 8

Risk Governance

WORKING PAPER ON NATURE BASED SOLUTIONS

Implementation: Status, Challenges and Benefits

IMPRINT

This working paper is a result of the EUSALP Action Group 8 – Risk Governance of the Work Plan 2023 – 2025.

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3 Introduction and definition

The Alpine region is an important living and economic area but is also exposed to natural hazards. According to the synthetic report 2023 of the intergovernmental panel on climate change, global warming has an especially high effect on mountain areas like the Alps. This leads to an increase of weather extremes as well as a higher risk of damage from natural hazards and the loss of safe settlement areas. Nature-based Solutions (NbS) can play an important role in this context to mitigate the risks of natural hazards and to adapt to climate change.

EUSALP Action Group 8 (AG8) wants to deepen the knowledge and understanding of the role of Nature-based Solutions in the field of climate change adaptation and natural hazard management. This working paper is based on the results from previous papers, especially the policy brief "Nature-based Solutions in the context of Natural Hazards" from the Natural Hazard Working Group (PLANALP) of the Alpine Convention, the project from the German Federal Environment Agency "Nature-based solutions in the Alpine region: Using ecosystem functions to promote climate mitigation and adaptation measures. Creating new nature-centred governance mechanisms across sectors and policy levels", the IUCN Global Standard for Nature-based Solutions from 2020 and the input paper from the Alpine climate board of the Alpine Convention "Nature-based Solutions and their Governance Structures for Climate Actions in the Alpine Region". The main parts of the results are from the international workshop on 13 June 2024 organised by AG8, which took place during the conference INTERPRAEVENT 2024 in Vienna.

The challenge with NbS already starts with the definition. There is not one common definition of NbS in the field of natural hazard management and climate change adaption, this was also demonstrated by the international workshop. For this paper, Action Group 8 has decided to use the definition of the policy brief by PLANALP:
Nature-based Solutions are actions that work with and enhance nature to restore or create a protective function for society from the impacts of natural hazards. NbS are based on and use the power of nature as infrastructure to provide natural services, to benefit society and environment.[1]

[1] Natural Hazard Working Group of the Alpine Convention (PLANALP), mandate 2021-2022

4 Obstacles and challenges

Nature-based Solution are a crosscutting area that bring together different sectors and actors. This requires an intensive collaboration between all involved stakeholders and can lead to challenges in coordination, knowledge gaps and competing interests. Therefore, establishing and utilizing synergies across the related areas constitutes a critical prerequisite for the effective implementation of Nature-based Solutions. The implementation of NbS should ensure that affected populations are protected from natural hazards, while simultaneously generating economic benefits, preserving biological and cultural diversity, and maintaining the capacity of ecosystems to adapt and evolve over time. Besides that, Nature-based Solution faces according to the AG8 and the outcomes of the international workshop four main challenges:

1) Knowledge and legal gaps

One of the most important obstacles for the implementation of NbS is the gap between theory and practice. Which is often caused by the limited awareness and knowledge regarding NbS as well as their potential and is accompanied by a lack of technical expertise among practitioners and decision-makers. Additionally, legal and administrative frameworks are currently missing. For a large-scale and successful implementation, frameworks or guidelines that are also reflected in political objectives are necessary.

2) Insufficient financing

Financial constraints also play a decisive role, since dedicated funding streams for NbS are often absent, leaving projects underfinanced or not financed at all.

3) Conflicting interests

Issues such as property rights, availability of space, and conflicts of land use frequently hinder the integration of NbS into planning processes.

4) Lower level of acceptance

At the political and societal level, NbS are sometimes perceived as unreliable and that they offer a lower level of protection compared to technical systems. This perception is reinforced by the fact that NbS require time to develop their full protective capacity, demand regular maintenance, and are subject to natural uncertainties.

Another significant challenge is that NbS are often highly selective and only partially inclusive, addressing single functions or benefits rather than fulfilling their potential as transformative and

multifunctional measures. This narrow application undermines the broader societal, ecological, and economic co-benefits that NbS are intended to deliver.

5 Benefits

Despite these challenges, NbS provide valuable key benefits. They contribute to improved physical and mental health by offering recreational opportunities and accessible green spaces for current and future generations. Social inequalities can be addressed by designing inclusive spaces that benefit diverse communities. Regarding biodiversity and ecology, NbS preserve and restore ecosystems from which can have positive effects on the biodiversity. Furthermore, it protects cultural landscapes, all while maintaining adaptability under changing climatic conditions. They also strengthen mitigation and adaptation capacities, enabling effective responses more effectively to extreme events and the management of cascading impacts or multiple hazards simultaneously. Importantly, these benefits are achieved without causing environmental degradation, making NbS a more sustainable form of risk management.

6 Differences between NbS and technical measures

The decision on the appropriate protective measure depends on many factors. One of the most important is the function and impact the measure has on the natural hazard processes. For NbS it has to be defined which societal challenges are addressed, which ecosystems can be used, what the functional capacity of the ecosystem is and how it has to be managed. Important to notice is that NbS often cannot replace technical measures, as they might not reach the desired level of safety. They are often implemented in a combination with other measures to complement each other. Nevertheless, a comparison between NbS and technical measures can be an important basis for decisions.
NbS have significant advantages compared to technical measures. Their multifunctionality allows them to deliver ecological and social benefits while managing multi-hazards at the same time. They also tend to be more cost-effective over time and have an enhanced life cycle. Compared to technical measures NbS is reducing the vulnerability to climate change impacts and offer solutions that are more flexible and adaptive. Furthermore, they encourage public engagement and participation in planning and management processes, thereby reinforcing community ownership and resilience.
However, there are also disadvantages compared to technical measures. While technical measures have standardised frameworks, regulations and modelling systems, NbS is still missing those, which

makes the implementation process much harder. In addition, NbS is less predictable in the development and uncertainties inherent to natural processes make outcomes more difficult to guarantee. Their effectiveness may vary depending on ecological conditions, and in many cases, they require longer timescales to develop before full protection can be achieved. This often conflicts with the political and societal demand for fast, visible results. NbS also needs a higher collaboration than technical measures as it is a crosscutting area with different sectors and stakeholder involved. Additionally, the shortage of qualified professionals with relevant expertise constrains their broader application.

7 Selected pilot examples

To illustrate the application of NbS, this chapter contains selected practical examples from the various member countries of Action Group 8.

Name of NbS	Gewässerbetreuungskonzept Untere Ahr / River corridor management plan Untere Ahr (South Tyrol)
Achieved NbS goals	☒Multifunctional benefits ☒Lower costs (creation and maintenance) ☒Enhanced Life cycle ☒Reduced vulnerability to climate change ☒Improved public participation ☐Reduced social inequalities ☒Improved biodiversity/natural environment ☒Positive impacts for inhabitants (eg creating new recreation area)
Impressions	 Figure 1: View to the Tauferer Tal Valley. © Civil Protection Agency – Autonomous Province of Bolzano  Figure 2: Before and after river restoration measures in the Gatzaue, one of the key areas of the restoration measures in the river corridor of the river Ahr. © Civil Protection Agency – Autonomous Province of Bolzano
Description	Based on the EU Water Framework Directive (2000/60/EC) and the Floods Directive (2007/60/EC), the relevant authorities should coordinate flood protection and nature conservation demands, ideally achieving synergies. Keeping this in mind, the Civil Protection Agency of the Autonomous Province of Bolzano has worked for over 20 years on the Lower Ahr river corridor management plan on the valley floor from Sand in Taufers to Bruneck, a 18 km long and about 1,3 km white river corridor. However, the best technical solution for eliminating the identified flood risk — adjustable flood retention basins on the valley floor — could not be implemented due to opposition from farmers and

	politicians. Instead, 19 river restoration measures with a length of 6,4 km have been successfully implemented on the Lower Ahr since 2002. These measures included river widenings and the creation of side arms on public water estates to restore former floodplain sites separated from the river by constructions. These sites are vital alluvial forest areas. These improvements have enhanced the habitat and flood retention along the river Ahr on the valley floor. Another valuable result is the strong trust between the authorities and stakeholders, as well as the population's increased awareness of the importance of a near-natural river landscape.
Period of implementation	Started 2000 and ongoing
Costs/ funding	The total costs are 6 Mio Euros with 5,5 Mio Euros for the NbS measures and 0,5 Mio Euros for the planning activities. Autonomous Province of Bozen, EU Interreg IIIB (Riverbasin Agenda2003-06)
Stakeholders	Autonomous Provinz of Bolzano, municipalities of Bruneck, Gais, Sand in Taufers
Obstacles	Die Befürchtung, dass ein zu hoher Grundwasserspiegel die gewohnte Bewirtschaftung Felder beeinträchtigen könnte. The neighbors and landowners feared that a possible higher groundwater level could impair the usual cultivation of fields.
solutions and successes	Widening the river and adapting the terrain increased flood retention outside settlement areas and slightly reduced the flood risk. The habitat for species protected under the FFH Directive has been improved.
Additional information	The hazard release of flood risk areas would require the provision of extensive agricultural land. A compensation model for landowners is currently being developed for the provision of this land.

Name of NbS	LIFE Lech - Dynamic River System Lech (Austria)
Achieved NbS goals	☒Positive impacts for inhabitants (eg creating new recreation area) ☒Lower costs (creation and maintenance) ☒Enhanced Life cycle ☐Reduced vulnerability to climate change ☒Improved public participation ☐Reduced social inequalities ☒Improved biodiversity/natural environment
Impressions	 Figure 3: Forchach Suspension bridge. © Bernhard Kogelbauer  Figure 4: Revitalisation Lech. © Bernhard Kogelbauer
Description	The LIFE Lech – Dynamic River System Lech project focused on 13 hydraulic engineering interventions along with a series of nature conservation measures aimed at re-establishing natural river dynamics. These efforts were concentrated primarily on the upper course of the Lech River between Holzgau and Vorderhornbach, with additional targeted actions in selected sections of the middle and lower reaches and at the German border. Throughout the 20th century, river regulation efforts to create space for settlements and agricultural use led to a deepening of the riverbed. This process came at the expense of the river's natural dynamics and its connection to the forelands, ultimately resulting in a significant loss of habitat for specialized animal and plant species. The implemented measures were based on the Lech River Development Concept, developed during the first LIFE project and further refined in the current project. Taking potential flood risks as well as fostering habitats for certain endangered species into account, the project involved removing bank stabilization structures, widening the riverbed, creating side channels, and shortening groynes—all aimed at giving the river room to regain its natural dynamics without reducing flood risk for relevant

	infrastructure. Additionally, numerous pioneering habitats, mainly in flood-prone foreland areas were established. In total, approximately 23 hectares of new active river channel and 62 hectares of additional potential active area were created within the intervention stretches. To secure the long-term success of these efforts, a monitoring programme was launched and a management plan for the coming years was developed. The chosen measures are expected to be resilient to both hydraulic and climatic changes, as they promote a high degree of natural dynamics and improve flood retention within designated flood-prone zones.
Period of implementation	2016 - 2022
Costs/ funding	Total costs: 6.09 million € - European Union (LIFE) 3.65 million € (share of funding: 60%) - Federal Water Engineering Administration (BWV): 1.92 million € - Tyrolean Regional Government, Department for Environmental Protection: 0.32 million € - Water Management Administration Kempten: 0.17 million €
Stakeholders	- Water Engineering Administration of Tyrol, representing the Federal Water Engineering Administration (BWV), Austria - Tyrolean Regional Government, Department for Environmental Protection, Austria - Water Management Administration Kempten, Germany - Tyrolean Lech Nature Park - District Administration of Reutte - Municipalities of Bach, Ehenbichl, Elbigenalp, ElmenHäselgehr Forchach, Lechaschau, Pinswang, Stanzach and Vorderhornbach - Tourism Associations Naturparkregion Reutte and Lechtal Tourismus - *Reutte District Forest Authority* - Tyrolean Fishing Association
Obstacles	The large-scale implementation of redynamisation measures requires sufficient land availability. Fortunately, extensive areas of the Lech forelands are part of Public Water Property, making them accessible for the planned interventions. Public concerns raised by private individuals regarding specific project components were successfully addressed through effective local communication and strong networking. Gaining the support of committed local partners and on-site personnel proved essential in fostering broad acceptance within the local community of both the scope of the intervention and the necessary use of machinery.
solutions and successes	The interdisciplinary project team's commitment to shared common goals enabled an efficient, solution-focused approach, culminating in the successful realisation of a large-

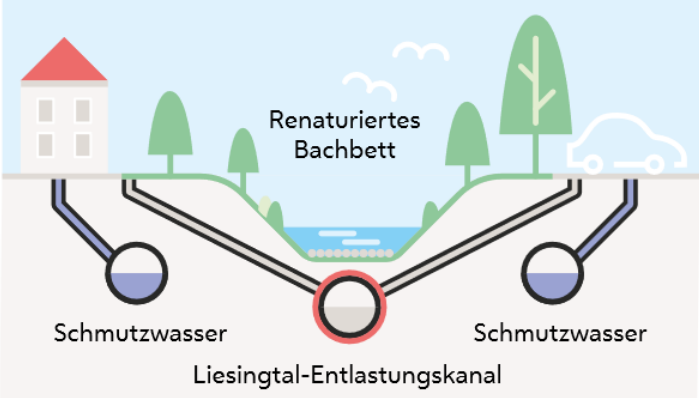
	scale revitalisation project within a relatively short timeframe. Active and ongoing communication with all stakeholders ensured that emerging questions were addressed promptly and potential issues resolved in a timely manner. By using interdisciplinary synergies and fostering knowledge transfer within the project team, the team was able to maximise the aimed impact and value of outcome. These efforts were honoured with a nomination for the finalists of the LIFE-awards 2023, recognising excellence in nature protection, environment and climate action by the European commission.
Additional information	https://www.life-lech.at/ https://www.cipra.org/en/projects/nature-based-solutions-and-their-governance-structures-in-the-alpine-region https://climate-adapt.eea.europa.eu/en/mission/solutions/mission-stories/restoring-wild-river-ecosystems-lech-story40

Name of NbS	Protective Forest Restoration in Bavaria (Germany) Weißwand - example for nature based solution
Achieved NbS goals	☒Multifunctional benefits ☒Lower costs (creation and maintenance) ☒Enhanced Life cycle ☒Reduced vulnerability to climate change ☐Improved public participation ☐Reduced social inequalities ☒Improved biodiversity/natural environment
Impressions	 Figure 5: Protective Forest Restoration Weißwand. © AELF Rosenheim
Description	Restore and rebuild protective forests so they can protect people and infrastructure in the Bavarian Alps against natural hazards such as rockfall, mudflows, landslides and avalanches and also to protect the soil and site from erosion und humus depletion. Protective forests are particularly important for flood protection and providing clean drinking water. To reach this goal targeted measures such as tree planting, shoring against forest avalanches and sliding snow are done. Accompanied by targeted regulation of ungulates. Relying only on technical measures would be much more expansive. NbS improves also the natural habitat.
Period of implementation	Started 1986 and ongoing
Costs/ funding	The program is funded by the bavarian state. Investment at Weißwand since 1986 around 1.1 Mio € for tree planting, 1.7 Mio € for temporary barriers against forest avalanches and sliding snow (1986 to 2022) for an area of around 11 hectares. The overall investment from the forestry sector (incl. personnel & administration) is around 3.9 Mio €. The water management offices invested in the obstruction of avalanche tracks/paths around 20,7 Mio. € and the road construction offices invested in 4.5 km of rockfall protection fencing around 5 Mio. €.

Stakeholders	Bavarian forest administration, Bayerische Staatsforsten AöR; water management office; road construction office; nature conservation office.
Obstacles	Rapidly advancing climate change in mountain areas and the long time needed to rebuild forests in mountain areas. Also increasing number in natural hazards and conflicting interests.
solutions and successes	All parties involved must work closely together. The regulation of ungulate populations has a decisive role in the success of the restoration measures as the young trees need a long time to grow and full fill there “protective function”.
Additional information	https://www.lwf.bayern.de/waldbau-bergwald/schutzwaldmanagement/index.php https://www.stmelf.bayern.de/wald/wald_mensch/schutzwald-der-wald-bewahrt-vor-naturgefahren/index.html

Name of NbS	Delémont — Delémont Marée Basse: River revitalisation and flood protection project on the Sorne (Switzerland)
Achieved NbS goals	☒Multifunctional benefits ☐Lower costs (creation and maintenance) ☐Enhanced Life cycle ☒Reduced vulnerability to climate change ☒Improved public participation ☐Reduced social inequalities ☒Improved biodiversity/natural environment
Impressions	 Figure 6: Revitalisation at Sorne. © Markus Forte | Ex-Press | BAFU  Figure 7: Revitalisation of the channel. © Groupements GBE et GE
Description	The project addresses flood risks posed by the Sorne (flooding caused by extreme rainfall events) and combines flood protection with revitalisation: widening and naturalising the riverbed, creating floodplains, renaturalising riparian zones, improving ecological connectivity and enhancing the quality of leisure and landscape. The aim is both to reduce risk and to enhance the ecological and social value of the urban space. NbS targets achieved (compared to conventional projects) • Increased retention and delay of runoff through widening and gravel islands (instead of just higher walls). • Improved habitat quality and biodiversity (restored riparian strips, floodplain areas). • Social added value: better local recreation and visibility of river nature in urban areas.

	• Flexibility/resilience: Areas can be temporarily flooded during extreme floods instead of endangering residential areas. In contrast to purely technical solutions (dams, wall reinforcements), NbS are multifunctional — however, the disadvantage is often greater space requirements and longer implementation/acceptance phases.
Period of implementation	Staged program: initial planning began in 2007; several construction phases have taken place since then. The project is being implemented in stages and is expected to continue until 2026.
Costs/ funding	Framework credit of approx. CHF 22 million (approved by referendum with 82% public support). Funding comes from federal, cantonal and municipal sources, with significant subsidies and grants (in some phases up to ≈ 80 % support), as well as third-party contributions and private partners.
Stakeholders	City of Delémont (project owner); cantonal authorities; federal agencies (e.g. FOEN – Federal Office for the Environment, project funding); engineering and planning companies; local associations (e.g. WWF Jura); funding partners (such as insurers or sponsors); and the local public, whose participation formed part of the planning process.
Obstacles	• Limited space in urban river sections (channel widening reduces available building land). • Conflicts with existing river walls and infrastructure (e.g. encroachments by buildings and bridges). • Construction-related disturbances (increased turbidity, temporary habitat loss). • Complex financing structure across multiple stages and funding sources.
solutions and successes	Participatory planning process and phased implementation to distribute costs and impacts; broad public approval through referendums. • Technical compromises: combination of local retaining walls where necessary and river widening in other segments. • Ecological achievements: visibly broader, more natural riverbed with gravel islands, pioneer vegetation and improved habitats; overall reduction in visible flood damage in the affected neighborhood since implementation of the measures.
Additional information	Delémont marée basse Magazin «die umwelt» 2/2020 – Naturgefahren gehen alle an (page: 29-31) Conception « Paysage suisse », objectif 7 : Laisser libre cours à la dynamique naturelle - YouTube

Name of NbS	Integrative flood protection at the river Liesingbach (Austria)
Achieved NbS goals	☒Multifunctional benefits ☐Lower costs (creation and maintenance) ☒Enhanced Life cycle ☒Reduced vulnerability to climate change ☐Improved public participation ☒Reduced social inequalities ☒Improved biodiversity/natural environment
Impressions	 Figure 8: NbS project at river Liesingbach. © Stadt Wien – Wiener Gewässer MA 45, 2023
Description and objectives	Renaturalisation to improve the flood protection system and water quality and create new space for flora and fauna as well as recreation areas for residents. During the project, a new relief channel for rainwater is built directly underneath the riverbed. With the channel the river is relieved during floods, the water quality increases and space for new green areas are provided. In addition, a flood storage basin was build. On the surface, the river landscape was renaturalised by partially widening the riverbed and flattening the banks, sealing the riverbed with natural materials, and removing high steps to ensure fish movements. To protect against erosion, the riverbanks were stabilized using bioengineering techniques and the bank areas were planted with vegetation.
Period of implementation	2022 until 2027
Costs/ funding	The City of Vienna and the Austrian Ministry of Agriculture and Forestry, Climate and Environmental Protection, Regions and Water Management fund the project. The total costs are 85 Mio Euros with 27 Mio Euros for the NbS measures and 58 Mio Euros for the channels, flood storage basin and other technical measures.

Stakeholders	City of Vienna
Obstacles	• Very high costs • High percentage of technical measures • Mitigation mainly through technical measures than NbS directly
Solutions and success	The project costs were covered by the city of Vienna. The project not only created protection, but also a new habitat for animals and a recreational area for residents. However, it could only be implemented by using technical measures, only NbS would not have provided the desired protection.
Additional information	https://www.wien.gv.at/spezial/liesingbach-renaturierung/

Name of NbS	Flood Protection project in the Gradaščica River basin (Slovenia)
Achieved NbS goals	☒Multifunctional benefits ☒Lower costs (creation and maintenance) ☒Enhanced Life cycle ☒Reduced vulnerability to climate change ☒Improved public participation ☐Reduced social inequalities ☒Improved biodiversity/natural environment
Impressions	 Figure 9: Phase 1A - implemented „green measures“ at Gradaščica River basin. © DRSV, Slovene Water Agency
Description and objectives	The Water Agency of the Republic of Slovenia is implementing flood protection measures within the framework of the project Flood Protection Arrangement of the Gradaščica River Basin. The objective of the project is a comprehensive regulation of the Gradaščica River basin, thereby significantly improving flood safety in the inhabited areas of southwestern Ljubljana, Dobrova, Razori, Stranska vas, Dolenja vas, Šujica, and Polhov Gradec. The project is being carried out in several phases: Phase 1A – Works within the area of the City Municipality of Ljubljana: Regulation of the Mali Graben, the Horjulka and the Gradaščica rivers within the territory of the City Municipality of Ljubljana, arrangements in the wider Kozarje area, the surplus material deposit site Gameljne, and all associated works. Phase 1B – Works within the area of the Municipality of Dobrova–Polhov Gradec: Regulation of the Gradaščica River in Dolenja vas, the Božna and Mala voda rivers in Polhov Gradec, and the Gradaščica River in Šujica, including all associated works. Phase 2 – Razori dry retention basin Phase 1A focused on the implementation of flood protection measures along the Gradaščica River within a highly urbanised area, including river regulation and the construction of a flood diversion channel. The phase combined grey and green infrastructure solutions and has already been successfully completed. Phase 1B comprised additional flood protection measures on the Gradaščica River and its tributaries, primarily through river regulation works. This phase has also been fully implemented and completed.

	Phase 2 includes flood protection measures on the Gradaščica River and its tributaries, with a focus on the construction of a dry retention reservoir and further river regulation works. Similar to Phase 1A, it combines grey and green solutions and is currently in the planning stage. Already implemented measures (Phase 1A) includes nature-based solutions, which will be in next years monitored in Nature-Demo project–DEMO Site 3.
Period of implementation	The Gradaščica Project is implemented under the Operational Programme for the Implementation of the EU Cohesion Policy 2014–2020, Priority Axis 5: Promoting climate change adaptation, risk prevention and management, Priority Investment 5.1: Supporting investment for climate change adaptation, including ecosystem-based approaches, and contributes to achieving the specific objective of reducing flood risk in areas of significant flood impact. Start date: 1 July 2016; End date: 31 December 2023.
Costs/ funding	Estimated costs: 67,738,032.10 EUR (85% EU Cohesion Fund, 15% State Budget of the Republic of Slovenia). For Gradaščica Flood Protection Project the EU has contributed EUR 57.5 million and will protect 17,800 inhabitants and 3.108 facilities.
Stakeholders	The project is co-financed by the Republic of Slovenia and the European Union through the Cohesion Fund. City Municipality of Ljubljana, Municipality of Dobrova–Polhov Gradec
Obstacles	The project comprises more than 180 flood protection measures and arrangements at various locations. Extensive coordination is required with spatial planning authorities and local stakeholders, with the main challenge being the coordination of Phase 2 – the flood control dry retention basin, located in the upstream municipality for the benefit of the downstream City Municipality of Ljubljana. A particular challenge lies in the design and implementation of nature-based solutions (NbS) along the downstream sections (through the city of Ljubljana) from the planned flood retention basin (to be constructed in the final phase). The solutions must be immediately effective and resilient to more demanding high-water conditions than those expected after the completion of the entire project.
Solutions and success	Until now, 7.5 km of the Gradaščica River and Mali Graben channel were revitalised (Phase I), enlarged, and locally NbS elements were applied (channel widening, islands, side channels, fish refuges, bank vegetation – trees and bushes).
Additional information	https://www.gov.si/assets/organi-v-sestavi/DRSV/Dokumenti/Dogodki/Usmeritve-za-vkljucevanje-NBS-v-projekte-za-zmanjsevanje-poplavne-ogrozenosti_nov-2024.pdf https://gradascica.si/wp-content/uploads/2020/03/video_razori.mp4 https://gradascica.si/wp-content/uploads/2020/03/video_maligraben.mp4 Demo 3 | Ljubljana, Slovenia - Nature-Based Solutions for Demonstrating Climate-Resilient Critical Infrastructure http://gradascica.si/

8 Summary & conclusion

Nature-based Solutions represent a promising and multifunctional approach that integrates mitigation with ecological, biodiversity and social benefits. They offer unique advantages over technical measures in the term of long-term cost-effectiveness, adaptability to climate change. Their multifunctionality can allow them not only to address multiple hazards simultaneously but also to reinforce public participation and community ownership.

However, institutional, financial, and perceptual barriers limit the implementation of NbS. They are often highly selective and only partially inclusive, focusing on single benefits rather than realizing their potential as transformative, multifunctional measures. In addition, their establishment requires longer timescales, continuous maintenance and management. To realize NbS on a larger scale, further progress is required in the development of standards, modelling and monitoring systems, technical capacity building and dedicated funding mechanisms.

In order to utilise the full potential of NbS, effective cooperation between the different relevant stakeholders is necessary and they must have the necessary knowledge of the application of NbS, including the benefits and challenges or limits.

A balanced strategy that combines NbS with other measures offers the most effective pathway toward building resilient, adaptive, and sustainable environments in the face of increasing natural hazards and climate change.