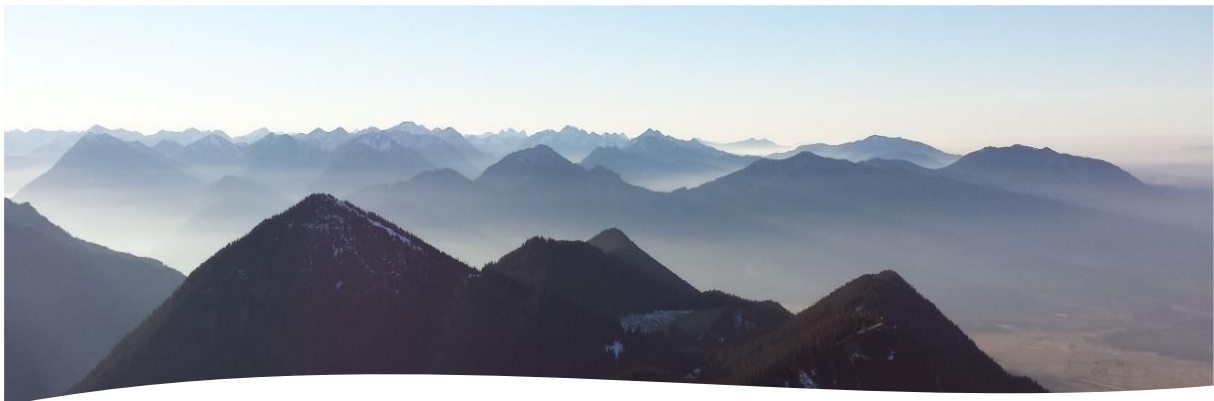

Nature-based Solutions and their Governance Structures for Climate Action in the Alpine Region

***Proposals for the establishment of nature-oriented,
collaborative, cross-sectoral, and multi-level governance
mechanisms fostering the use of ecosystem services to
tackle the climate crisis***



INPUT PAPER



**ALPENKONVENTION
CONVENTION ALPINE
ALPSKA KONVENCIJA
CONVENZIONE DELLE ALPI**

IMPRINT

This paper is a contribution of the German Federal Environment Agency (UBA) to the mandate of the Alpine Climate Board, chaired by Austria. The paper was elaborated by ifuplan and CIPRA International, with inputs from the Board members.

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EXECUTIVE SUMMARY

The **German Federal Environment Agency** initiated the project “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” to raise awareness about the fundamental relevance of nature-based solutions (NbS) for the Alpine area and the opportunities they offer to promote biodiversity and human well-being while mitigating climate change and its impacts. Within this project, **ifuplan and CIPRA International** analysed already implemented NbS projects in the Alpine region and the governance mechanisms behind them, evaluating key success factors and challenges.

This paper summarises the results of the **project analysis**, the inputs from an **international project workshop** held in September 2024, the derived **conclusions and recommendations** to political stakeholders and further actors of the Alpine Convention. The results will be presented to the **XVIII Alpine Conference in January 2025**. They may serve as a basis for the future work of the **Alpine Climate Board**, in collaboration with other **Thematic Working Bodies of the Alpine Convention**. Recommendations and insights may be considered during the **Italian and German Presidencies** of the Alpine Convention 2025-2026 and 2027-2028, respectively.

The authors of this paper analysed **8 NbS pilot projects** with various implementation sites in Austria, Germany, France, Italy, Liechtenstein, Slovenia, and Switzerland. They cover the following sectors of the Alpine Climate Target System: “Ecosystems and Biodiversity”, “Mountain Agriculture”, “Mountain Forestry”, “Natural Hazards”, “Soil”, “Tourism”, and “Water”. All projects provide approaches to adapt to the impacts of climate change and some help to actively mitigate climate change by enhancing the sequestration of greenhouse gases. The projects vary greatly in terms of size, addressed sectors, and number of project partners and stakeholders involved. (Chapter 2).

Based on the **analysis of aspects** relating to **biodiversity, climate change mitigation and adaptation, socioeconomic impact, and governance** (Chapter 3), the authors derived the following **requirements** for a successful establishment of NbS in the Alpine region (Chapter 4):

- Regarding **space**, the successful establishment of NbS requires mechanisms for two approaches: a **bottom-up-approach**, starting from small projects and spreading or upscaling them, and a **top-down approach**, implementing large-scale solutions at individual project sites.
- The successful establishment of effective and sustainable (in terms of time and function) NbS requires **adapted temporal management approaches**: While some projects, especially proven and directly effective small-scale NbS, need targeted promotion and funding to spread rapidly, NbS based on complex natural processes require (new) concepts for long-term thinking, long-term management and adaptive governance.
- A **smart combination of public funding and the utilisation of private resources**, supported by adapted institutional frameworks is highly relevant for the successful establishment of NbS. Public funding needs to be promoted and **easily accessible for project applicants across sectors**.

- The widespread establishment of NbS requires a **binding legal framework, standardised evaluation criteria, and institutionalised support structure**.
- Ensuring the establishment of NbS requires efforts to **raise public awareness and to build up capacities** by offering easily accessible education and training on theoretical NbS approaches and how to transfer them into action as well as exchange formats among stakeholders.
- The successful establishment of NbS requires **‘good’ and case-adapted governance mechanisms**. This will facilitate cross-sectoral and interdisciplinary collaboration with a special focus on transparency and continuous communication, and increase the acceptance of NbS among landowners, (private) investors, planners, public administration and policy makers.

As a result of the comprehensive analysis of NbS projects, recommendations to foster NbS projects in the Alpine region are compiled in Chapter 5.1, relating to the following aspects:

- **Governance and Communication Mechanisms Fostering NbS:** Anchor cross-sectoral approaches in the policy mix in the Alpine region, offer training sessions for all NbS stakeholders to build-up capacities, and promote positive narratives by disseminating NbS success stories.
- **Integration of Nature-based Solutions into Decision-Making Processes:** Incorporate NbS at different policy levels, foster the involvement of decision makers and stakeholders, and integrate NbS into existing programmes like the Multi-Annual Work Programme of the Alpine Conference.
- **Practical Implementation of NbS:** Pursue both bottom-up and top-down approaches. Identify suitable areas for NbS in the Alpine region, use NbS to tackle challenges at the local level, and integrate NbS into Alpine-wide, national, regional, and local planning instruments and strategies.
- **Tools:** Elaborate a comprehensive and easy-to-use glossary of NbS, a collection of good practice examples, and a decision-making aid on the transferability of NbS.
- **Standardisation and Evaluation:** Develop a comprehensive catalogue to characterise NbS types and their benefits, a standardised economic valuation approach. Refer to established standards and provide technical guidelines to facilitate implementation.
- **Economic Aspects:** Create accessible and adapted funding programmes and foster a comprehensive approach for an economic evaluation of NbS, taking into account their complexity and making NbS comparable to technical solutions.

Further suggestions of the authors of this paper refer to (Chapter 5.2):

- **Social Engagement:** Encourage participation through innovative concepts like competitions, experiential learning projects, and volunteer involvement.
- **Spatial Planning:** Integrate NbS into planning instruments in all relevant sectors and at all levels.
- **Legal Instruments:** Favour NbS in public procurement, mandate small-scale NbS in building projects, and incorporate NbS in further sectors of law.

- **Supporting Bodies and Structures:** Make sure that existing or newly created specialised institutions at various levels can support interdisciplinary approaches, assist in planning and implementation, facilitate networking, and promote good governance practices.
- **Alpine-wide Interactive NbS-Platform:** Develop an open-access platform to aggregate information on NbS, including definitions, legal guidance, funding opportunities, case studies, monitoring results, educational materials, tools, and Web-GIS services for site proposals.

The **Alpine region has a high potential for the implementation of NbS in different sectors.** Specific political mandates to implement the recommendations could be set out in a “**Nature-Based Solutions Strategy for the Alps**”.

1. Preface and Introduction

Nature provides a multitude of services for humans, which are “*essential for human existence and good quality of life. Most of nature’s contributions to people are not fully replaceable, and some are irreplaceable.*” (ipbes 2019) Functioning ecosystems and biodiversity are the basis not only for human well-being but also for economic prosperity, particularly in the Alps with their high variety of climate and vegetation zones, a high probability of natural hazards but also an exceptional recreation value. The concept of Nature-Based Solutions (NbS) merges the scientific analysis of ecosystem services with the benefits they offer for human well-being as well as for biodiversity.

For this input paper, we follow the definition of NbS given by IUCN (2016):

“Actions to protect, sustainably manage, and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits.”

(Emphases by the authors)

This definition was confirmed and concretised by the United Nations Environment Assembly (UNEP 2022)¹, whose resolution contains the first multilateral agreed definition of NbS.



Figure 1 Basic concept of NbS (IUCN 2016).

According to the concept of NbS elaborated in (IUCN 2020), which is visualised in Figure 1, ecosystem-based approaches address seven major societal challenges: climate change mitigation and adaptation, disaster risk reduction, economic and social development, human health, food security, water security, as well as environmental degradation and biodiversity loss. Due to their nature, NbS provide approaches to overcome these challenges while preserving ecosystems, which are threatened by various factors, and strengthen their integrity and resilience.

¹ According to this resolution, “... nature-based solutions are actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits, ...”.

The Alpine region is particularly sensitive to the effects of the climate crisis. Changes in precipitation, temperature, and runoff not only influence ecological functions but also economic and settlement opportunities in the Alps and neighbouring areas. The exceptional ecosystem services provided by the Alps offer opportunities for integrated and cross-sectoral NbS approaches to mitigate the effects of and adapt to climate change.

An effective use of NbS requires to acknowledge the importance of ecosystem services and integrates them into decision-making processes, developing appropriate governance mechanisms at all levels. As NbS often have cross-sectoral and cross-border effects, they are particularly relevant for the Alpine Convention as a transnational agreement and are suitable for their establishment in the entire Alpine region. The Alpine Climate Board has therefore agreed to make NbS one its three cross-sectoral focus areas.

In view of these aspects, the German Federal Environment Agency initiated the project “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”. Within this project, *ifuplan* and *CIPRA International* analysed already implemented NbS projects in the Alpine region and the governance mechanisms behind them, looking for key success factors and challenges.

This paper pursues the objective to raise awareness about the fundamental relevance of NbS for the Alpine area and to offer recommendations to political stakeholders and further actors of the Alpine Convention at the XVIII Alpine Conference in January 2025. It may also serve as a basis for the future work of the Alpine Climate Board, in collaboration with other Thematic Working Bodies of the Alpine Convention. Recommendations and insights may be considered during the Italian and German Presidencies of the Alpine Convention 2025-2026 and 2027-2028, respectively.

2. Methodological Approach and Selected Pilot Projects

2.1. Selection Criteria and Procedure

According to the definition of NbS given in the introduction (see Chapter 1), they are characterised by three main criteria: they address one or several societal challenges, are beneficiary for biodiversity, and for human well-being. This combination of effects is essential to demark an NbS from a pure nature conservation measure on the one hand (e.g. the restoration of a single habitat in a creek or a specific species protection programme) and from a technology-based solution on the other hand (e.g. an avalanche defence wall or a flood protection wall).

Based on these considerations, the authors of this paper defined the criteria for the selection of NbS projects to be analysed in detail as follows:

1. Every NbS project has to:
 - a. show positive effects on biodiversity as well as human well-being and
 - b. contribute to climate change adaptation and / or mitigation as the overall societal challenge to be tackled.
2. Furthermore, it must already be (at least partially) implemented – aiming to exclude pure theoretical approaches – and it has to demonstrate relevant governance aspects.
3. Since the overall project focuses on the Alpine region, the authors specified the NbS criterion of addressing social challenges by linking it to the Alpine Climate Target System (ACTS) of the Alpine Climate Board (PSAC 2019): Every selected NbS project has to address at least one of the sectors “Water”, “Natural hazards”, “Mountain agriculture”, “Mountain forestry”, and “Soil” tackled in the target system. Due to the nature of NbS, the “Ecosystems & Biodiversity” sector is addressed by all NbS projects. Additionally, they often foster the “Tourism” sector as a side effect, which is indicated in the present pilot project analysis (see 2.3) but was not a focus topic.
4. Finally, each Alpine country should be represented.²

The definition of the criteria was followed by a two-stage selection process:

1. The authors carried out extensive research for NbS projects on various internet platforms, for instance on Interreg Alpine Space, PHUSICOS, OPPLA, UNA, PORTAL, and a general internet research via different search engines.
2. According to the defined criteria, the project team ranked the pre-selection and finally chose the 8 most promising pilot projects, covering different project scales.

The authors analysed the selected projects in detail. Regarding the governance aspects, they carried out interviews with representatives (e.g. project partners, representatives of regional governments in charge of NbS) of every selected project.

² The final pilot project selection achieves this goal partially, as no suitable NbS project in Monaco could be identified within the project’s time frame and Liechtenstein is only considered via the “Bergwaldprojekt” (see 2.3).

2.2. Governance Analysis

Governance aspects play a central role for the implementation of NbS. As size and complexity of NbS projects vary greatly, the corresponding governance mechanisms also show a large variety of forms and scopes.

In this paper, the term “governance” refers to the following **governance dimensions**:

- **Collaborative Governance:** This aspect refers to the **interaction of actors from different institutional contexts**, such as politics, administration, business, research and education, **and civil society**. For "good" governance, it is crucial to determine which framework conditions and formats are suitable to enable the most constructive involvement and cooperation possible between the individual actors, taking into account their respective logics of action and institutional agendas.
- **Governance in a Multi-Level System:** Depending on the content and tasks, different levels are involved in governance processes: the **local level** (municipality), the **regional level** (county, district, etc.), the federal state level (region, province, department, federal state, etc.), the **national level** (state) and the **transnational level** (e.g. Alpine region, EU). **Cross-border governance** is a special form of bilateral or trilateral governance between neighbouring states. The more levels and states are involved, the more complex and demanding the governance setting becomes. Here, too, the question arises as to which innovative formats and cooperation models are suitable to enable the most effective cooperation possible between the various actors regarding regulation of responsibilities, competencies, decision-making models, etc.
- **Cross-Sectoral Governance:** Many collaboration processes, particularly in the field of NbS, **involve actors from different sectors**, e.g. nature conservation, agriculture, forestry, tourism, healthcare, water management, spatial planning, construction, urban planning, etc. Here, the aim is to develop new forms of cooperation and innovative alliances that enable the effective implementation of measures and projects.

To cover multiple facets of governance, the authors based the governance analysis on the topics and questions listed below. The interviews conducted with several stakeholders provided the corresponding information for every project (see Chapter 3.4).

1. Partners and Stakeholders Involved

- Which partners and institutions are directly and indirectly involved?

2. Form and Intensity of Cooperation

- In which form do the actors involved work together? How are cooperation, internal and external communication regulated?
- Is there a project organisation with committees for specific tasks? Has a steering group been set up? Has a process design or flowchart been developed for the project?
- Has external process support and moderation been commissioned?

3. Differences of Interest, Conflicts, and How to Deal with Them

- What were the greatest differences of interest and conflicts among the actors involved? To what extent did these conflicts escalate?
- How were the conflicting interests and conflicts managed or negotiated?

4. Successes and Challenges

- What were the main successes of the project from a governance perspective?
- What were the key success factors?
- What were the main obstacles regarding governance and how were they overcome?

5. Transferability

- What findings from the project can be transferred to other projects or be generalised?

2.3. Selected Pilot Projects

Several of the 8 selected pilot projects and their implementation sites are located in each Germany, Italy, Austria, France, and Switzerland. Liechtenstein and Slovenia are represented by one project each.

Three-quarter of the pilot projects are related to different aspects of water. Also, the sectors “Soil”, “Natural Hazards”, “Mountain Agriculture”, and “Tourism” are addressed multiple times (in 5, 4, 3, and 4 projects, respectively). One project has a particular focus on “Mountain Forestry”. To a smaller or larger extent, all projects provide approaches to adapt to the impacts of climate change. Half of the projects additionally help to actively mitigate climate change by enhancing the sequestration of greenhouse gases.

The following info boxes present the key facts of the selected pilot projects regarding their scale, their beneficial impacts for biodiversity and human well-being, their contribution to climate change adaptation or mitigation, as well as their characteristic governance aspects.



Allgäuer Moorallianz
Germany


Scale: Multiple project sites; county level

Biodiversity: Peatland restoration; protecting moor-specific species; biotope network

Climate change: Reducing greenhouse gas emissions; flood and drought protection

Human well-being: Adapted agriculture; recreation; scientific interest

Governance: Special-purpose association; connecting regional development and nature conservation; multidisciplinary collaboration; voluntary principle



Alternative Rainwater Management in the Parc Ouagadougou of Grenoble
France


Scale: Single project site; municipal level (city quarter)

Biodiversity: Inner-urban semi-natural habitats; diversification of wetland-specific species

Climate change: Flood and sewer overload prevention; saving drinking water resources; local climate regulation

Human well-being: Recreation; cost-efficient runoff treatment; educational elements


Governance: Collaboration between administration, planners, and neighbouring residents from the very beginning



LIFE Lech – Dynamic River System Lech
Austria and Germany

Scale: 13 implementation sites; watershed level
Biodiversity: Habitat restoration; species support measures
Climate change: Flood protection (additional retention volume of ca. 200,000 m³)
Human well-being: Fostering regional economy and job market; tourist attraction; education
Governance: Cooperative and clear steering and implementation structures; external facilitation; few parties involved; *challenge:* demand for large surface areas

Icons: Sustainable Development Goals (Water, Biodiversity), National Park, Tourism



Zürcher Bachkonzept
Switzerland

Scale: Various implementation sites; municipal level (City of Zurich)
Biodiversity: Habitat creation; repopulation by native animal and plant species; freshwater network
Climate change: Preventing urban flooding; increasing evaporation and groundwater recharge
Human well-being: Urban quality of life; increasing efficiency of wastewater treatment
Governance: Interdisciplinary approach; transparency; good technical implementation; *challenges:* technical and legal aspects, lack of knowledge, landowners

Icons: Sustainable Development Goals (Water, Biodiversity), National Park, Tourism



Bergwaldprojekt
Austria, Catalonia, Germany, Liechtenstein, Switzerland

Scale: Multiple project sites; transnational level
Biodiversity: Rebuilding climate-resilient near-natural forests; restoration of peatlands
Climate change: Reducing greenhouse gas emissions; protective forests; water retention
Human well-being: Sense of community; (active) recreation; education; forestry
Governance: High level of institutionalisation and coordination; code of conduct; clear lead; transparency; extensive involvement of volunteers


Icons: Sustainable Development Goals (Water, Biodiversity), National Park, Mountain Forests, Soil, Tourism



I-SWAMP – Integrated Small Wetlands of the Alps Monitoring and Protection
Austria, Italy, Slovenia

Scale: 17 implementation sites; transnational level
Biodiversity: Wetland habitat restoration; species support measures; biotope network
Climate change: Reducing greenhouse gas emissions; water retention
Human well-being: Education; natural heritage
Governance: Low level of steering mechanism; interdisciplinary planning; early communication; transparency; involvement of volunteers; *challenge:* landowners


Icons: Sustainable Development Goals (Water, Biodiversity), National Park, Mountain Agriculture, Soil



LIFE PASTORALP – Pastures Vulnerability and Adaption to Climate Change in the Alps
France and Italy

Scale: 2 pilot regions; transnational level
Biodiversity: Protecting pasture-specific habitats
Climate change: Options for climate-resilient pasture management
Human well-being: Cultural heritage protection; facilitating management decisions; agriculture
Governance: Interdisciplinary and participatory approach; open-access platform for easy replication and transferability

Icons: Sustainable Development Goals (Biodiversity), Mountain Agriculture



Rotational Pasture Management to increase the Sustainability of Mountain Livestock Farms in the Alpine Region
Italy

Scale: Single project site; farm level
Biodiversity: Positive effects on soil microbes and fauna, improved soil conditions
Climate change: Reducing greenhouse gas emissions
Human well-being: Cost savings (no need for supplementary feeding); longevity of pastures
Governance: Easy transferability to other farms

Icons: Sustainable Development Goals (Biodiversity), Mountain Agriculture, Soil

3. Results of the Cross-Project Analysis

3.1. Biodiversity Aspects of the Selected Pilot Projects

NbS projects often achieve benefits for biodiversity by **restoring specific habitat conditions**, e.g. through the restoration of peatlands, wetland, watercourses, etc. These measures usually promote the **local biodiversity** in single habitats and/or **protect endangered and rare species**. In addition, they contribute to the establishment of comprehensive **biotope networks**. By fostering and safeguarding ecological connectivity, these NbS can provide a valuable long-term benefit for biodiversity. Further important prerequisites to ensure a sustainable protection of habitats and hence a positive long-term effect on biodiversity are **knowledge and capacity building** combined with the **involvement of local stakeholders**. Many NbS projects integrate these aspects.

The pilot project analysis shows that land use and management practices concerning arable land, grassland, pastures, and forests have a significant influence on the diversity of flora, fauna, and fungi, as well as on soil functions. The projects achieve the protection of biodiversity through **adapted land use and management practices**, such as rotational instead of continuous grazing, fencing of particularly sensitive habitats, wet cultivation methods on peatlands, etc. Coincidentally, the conservation or promotion of biodiversity through NbS often has positive side effects with respect to improved ecosystem services, such as the creation or revaluation of recreational areas or better yields and more robust systems in agriculture and forestry.

3.2. Climate Change Mitigation and Adaptation Aspects of the Selected Pilot Projects

NbS, notably those related to peatlands, wetlands, forests, or ecologically intact soil functions, usually contribute to climate change mitigation by **actively sequestering atmospheric carbon** or **reducing emissions of carbon dioxide and other greenhouse gases** like methane and nitrous oxides from soils. The fixation of greenhouse gases is closely related to land use and management practices, which can influence biodiversity. NbS usually **promote ecologically sensitive land use methods**, in particular regarding the intensity of agriculture or forestry, or **adapted management strategies**, for example a decentralised instead of a centralised rainwater management. Many NbS relate to the **regulation of the water balance**, i.e. to the attenuation of surface or flood runoff, the retention of water in the soil or in the landscape, or to groundwater replenishment. Additionally, NbS have **local climatic effects**, by providing an enhanced evapo(transpi)ration or cooling effects, for instance. These are very important aspects insofar as the supply and drainage of water is becoming increasingly challenging as climate change progresses. One characteristic of climate change is the increasing probability for the occurrence of extreme weather events, like heavy rainfall, and associated natural hazards, like floods, mudslides, etc. NbS help **attenuating the impacts of such extreme events**: intact protective forests, for instance, prevent the formation of large mudslides or slow them down; natural riverbeds with floodplain forests or other adjacent unsealed floodplains provide space for water retention during floods or heavy rainfall events and help preventing the flooding of settlements. This may be the most resounding argument

from an economic perspective as the lateralisation of damages due to natural hazards is very costly – if not impossible, for example in cases of casualties.

3.3. Socio-Economic Aspects of the Selected Pilot Projects

NbS offer **social added value**, in particular by providing or often improving **recreational qualities of areas** or the **ability to experience ecosystems services**, by integrating **environmental education programmes** and interesting starting points for **scientific research**. In addition, NbS frequently promote a **sense of community** by creating places and platforms for exchange or involving the local population into the implementation process. Such opportunities for action can also be a valuable means of **combating the feeling of powerlessness** in view of the rapid progression of climate change.

Apart from that, the implementation of NbS often leads to **cost savings** or **efficiency gains**, regarding, for instance, the long-term maintenance for urban green spaces, an improved wastewater treatment, or lower insurance costs due to a higher resilience of ecosystems, and they can have positive effects for the **(regional) labour market** and the **regional economy**.

Many NbS projects contribute to the **preservation of cultural and natural heritage** and finally they usually contribute to the **protection or renewal of essential natural resources**, like groundwater as a source of drinking water or the yield capacity of soils to secure the food base.

3.4. Governance Aspects of the Selected Pilot Projects

The governance analysis of the selected pilot projects is based on the 5 topics and corresponding questions outlined in Chapter 2.2.

Partners and Stakeholders Involved

The number and types of directly or indirectly involved partners and stakeholders varied according to the size of the project. However, with a few exceptions, all **projects involved a wide range of stakeholders**, e.g. specialist departments from the administration, planning offices, consultants, research institutions, private sector, NGOs, intermediary organisations, citizens.

Form and Intensity of Cooperation

The form and extent of governance mechanisms (e.g. executive bodies, steering bodies, rules for decision making and internal as well as external communication) varied according to the size and complexity of the project (see Chapter 2.3). In **smaller projects, loose cooperation** between the partners involved was sufficient (e.g. “I-SWAMP”). **Large projects had clearly defined organisational structures and process designs** (e.g. “LIFE Lech”) **up to complete institutionalisation** (e.g. “Allgäuer Moorallianz” and “Bergwaldprojekt”). For larger projects, **steering mechanisms** were established, and internal or external **process facilitators and moderators** were commissioned.

Differences of Interest, Conflicts and How to Deal with Them

In the projects examined, classic **conflicts of interest** were observed, e.g. between the various sectors (**agriculture, water management, nature conservation**) and particularly between **project operators and landowners**. The different interests were considered in the projects. In most cases, the **negotiation of interests** took place in the course of the project implementation, on the one hand in the context of **communication and sensitisation measures** as well as **inspections** and on the other hand by **direct involvement**, which means by **integrating the interests of landowners and managers** directly into the project (e.g. the exchange of soil litter in the “Allgäuer Moorallianz” project, see Chapter 2.3).

Successes and Challenges

The most important success factors for good cooperation and coordination among the actors involved were the formulation of **clear project objectives**, a good **distribution of tasks and responsibilities** among the partners involved, clear **leadership** by the respective lead partners, the establishment of **steering mechanisms**, internal and external **transparency**, continuous **external communication** and **direct contact and exchange with those directly affected** by the project, especially the landowners. It was particularly important to **start the exchange at an early stage** to get the people affected on board and to take their interests into account from the outset. The main challenge was the refusal of single landowners in some of the project to collaborate.

Transferability

Generally, the concept of all the analysed pilot projects can be **transferred to other (Alpine) regions** with **similar topographical and structural conditions**. However, the **specific implementation** of NbS projects will **vary in each case** and needs **site-adapted concretisation**, taking into account, for instance, the local geology, fauna and flora, land use, administrative structure, national or regional legal requirements, cultural attitudes and practices, etc.

With respect to **governance aspects**, the following findings can be generalised and are **valid for all NbS projects**, independent of their location: **Successful NbS projects**, particularly those involving several project sites or project partners and affecting different stakeholders, are characterised by an **early involvement of all relevant actors**, notably affected landowners, a **professional framework for cooperation** between the various actors, a special focus on **transparency** and **continuous communication**, and a **high-quality implementation** of the measures: These aspects ensure the success of **interdisciplinary and cross-sectoral approaches**.

4. Conclusions and Derived Hypotheses

4.1. Cross-Sectoral Effects of Nature-based Solutions

NbS use the multiple functions and services of ecosystems, offering a comprehensive approach to link ecological and societal requirements. NbS can thus be an effective strategy as well as an important tool to tackle the large-scale socio-economic transformation we as society have to face to combat the climate and biodiversity crises.

The cross-sectoral dimension of NbS encompasses at least the following aspects:

Education

NbS re-connect people to nature and raise awareness for the benefits and services provided by nature. They can serve as a tangible approach for nature perception and environmental education at different levels, from schoolchildren to decision makers, guiding for example from single, visible species to scientific concepts about ecological connectivity.

Collaboration and Social Engagement

Usually, the successful implementation of NbS requires an intensive and interdisciplinary collaboration between different stakeholders. Good NbS governance can foster mutual understanding and strengthen the future collaboration between the involved parties. Additionally, it may promote the societal engagement of people affected by the NbS project.

Economic Effects

NbS are multi-functional and often more cost-effective in the medium to long term compared to technical solutions. For instance, the restoration of natural infiltration areas or water courses, reducing the hydraulic load of the sewage system, can reduce wastewater treatment costs significantly, as the example of the “Zürcher Bachkonzept” demonstrates; a protective forest may have substantially lower maintenance costs than a technical avalanche protection system, especially if the forest generates income through forestry utilisation. Furthermore, it is significantly cheaper to preserve existing ecological systems and use their functions than to restore them or develop new ones in order to compensate for ecological losses.

4.2. Requirements for the Establishment of Nature-based Solutions in the Alpine Region

Considering the results of the project analysis and the above-mentioned characteristics of NbS, the following requirements for the establishment of NbS in the Alpine region have been identified:

4.2.1. Spatial Requirements

Depending on the societal challenge addressed, the specific goal to be reached, and the type of NbS to be implemented, they have very different spatial requirements. It should be noted that the terms “large-scale” and “small-scale” can be interpreted very differently without specification.

In some cases, small areas are sufficient for the realisation of NbS, e.g. with respect to the planting of trees along a pedestrian street to provide shading and evapotranspiration, to roof or facade greening, to the use of artificial wetlands to treat surface runoff, or to the restoration and protection of single habitats, like spawning ponds for endangered amphibians. Beyond their local impact, small-scale NbS offer the opportunity to experiment with new solutions, realise pilot projects, and use them as best practice examples to raise public awareness, interest, and motivation for the implementation of NbS in the public as well as the private sector.

However, certain challenges, like the adaptation to droughts or a comprehensive flood protection require large-scale NbS. The restoration of a river flood plain, for instance, is usually associated with significant space requirements, depending on the size of the river and the local circumstances, regarding e.g. infiltration capacities, land use, geology, etc. This can harbour a high conflict potential, as space is generally limited in Alpine valley floors and many areas are privately owned or are already heavily built up with infrastructure and settlements.

The establishment and wide-spread implementation of NbS in the Alpine region therefore require both large-scale approaches and the promotion of small-scale projects. Hence, different planning levels should cooperate in the most effective and efficient way possible (see Chapter 5). The need to promote both approaches is particularly acute in the Alps: On the one hand, the Alpine specific natural hazards require large-scale solutions (e.g. the creation of retention areas for flood events or extensive protective forest areas); on the other hand, space is limited, especially for settlement areas, due to the topography, and therefore the realisation of many decentralised small-scale NbS is equally important.

Another spatial aspect is notably relevant with respect to flood protection: The most efficient flood protection measures in forms of NbS are located in the headwaters and upper reaches of rivers. NbS implemented there, like (semi-)natural retention areas, protect downstream residents and settlements and have therefore effects on areas far away from the implementation site – in cases of transboundary river basins sometimes even in a different state. This emphasises that NbS and their effects must be considered in very broad dimensions (spatial, temporal, financial, social, see also Section 4.2.2).

Based on these considerations, the following hypothesis can be derived:

Hypothesis I: Regarding space, the successful establishment of NbS requires mechanisms for two approaches: a bottom-up-approach, starting from small projects and spreading or upscaling them, and a top-down approach, implementing large-scale solutions at individual project sites.

4.2.2. Time Requirements

Also in terms of temporal aspects, different types of NbS require different approaches: Some NbS, especially small-scale projects, can be realised and show effects within a short range of time (i.e. within several months or few years), like the establishment of a decentralised rainwater management system in the “Parc Ouagadougou” in Grenoble (see Chapter 2.3).

Other NbS, however, that are based on complex ecosystem processes, such as the conversion to climate adapted forests on a large scale, soil formation, or the colonisation of habitats by certain species often require long periods of time. These processes follow different time schedules than human activities and associated NbS therefore require a long-term approach for successful implementation. Even if the initial measures of an NbS project can be carried out within a short timeframe, the desired effects and ecosystem services may only occur with a significant time lag due to the dynamics of natural systems. Conversely, this aspect also demonstrates the value of and the time saved by protective measures for existing ecosystems.

To ensure the appropriate management and acceptance of such long-term projects, as well as the monitoring and evaluation of their effects, the additional establishment of long-term, multi-dimensional and cross-sectoral governance mechanisms is necessary (successful examples are the projects “Allgäuer Moorallianz” and “Bergwaldprojekt”, Chapter 2.3). Such an approach could overcome the deficits of the currently prevailing logic of short-term visions. Furthermore, it offers long-term perspectives and planning security to landowners and stakeholders that are involved in these projects.

A transformation to long-term perspectives may be challenging for existing funding programmes because most of them, such as the Interreg Alpine Space Programme, are not designed for a long-term funding of implementation projects. They would thus require interfaces to long-term funding programmes at national and EU level to ensure follow-up funding after an initial project phase. A long-term funding could also be realised by compensation mechanisms or adapted market mechanisms (see Section 4.2.3).

Hypothesis II: The successful establishment of effective and sustainable (in terms of time and function) NbS requires adapted temporal management approaches: While some projects, especially proven and directly effective small-scale NbS, need targeted promotion and funding to spread rapidly, NbS based on complex natural processes require (new) concepts for long-term thinking, long-term management and adaptive governance.

4.2.3. Financial Requirements

NbS are usually based on or closely related to public goods, which are often not subject to general market mechanisms. In particular, there is a political agreement that public goods relevant to services of general interest, i.e. that are essential for the well-being of the population, like the provision of drinking water in good quality, should not be capitalised by the private sector. Therefore, it can be difficult to make the implementation of NbS economically attractive for enterprises or single persons.

For NbS projects that are not economically viable or are too large for single private investors, public funding can therefore be a decisive prerequisite for the realisation of NbS projects, particularly during their initial phase.

Some types of NbS, on the other hand, offer cost savings and efficiency gains (for instance, higher yields and an additional source of income like in the pilot project “Rotational Pasture Management”, Chapter 2.3) and may be economically more profitable than technical solutions. They may also have positive effects on the regional economy and labour market. These NbS, especially small-scale projects, may need promotion but don’t need public funding.

Another resource that can be utilised for the implementation of NbS are volunteers who invest time and financial resources out of personal interest rather than economic considerations. The involvement of volunteers has proven successful in several NbS projects (e.g. the “Bergwaldprojekt”, Chapter 2.2).

If the economic framework conditions are appropriate, the establishment of NbS may profit from a strong public support in terms of funding and an institutional setting (see also Section 4.2.4) as well as from private investments. Notably with respect to companies or associations, the private sector may offer a fast and highly dynamic establishment of new approaches, e.g. the set-up of sponsorship or voluntary programmes, fundraising campaigns, applied research, etc.

When assessing the economic viability of NbS and deciding on the allocation of public funds for their implementation, it must be taken into account that (according to their definition) NbS are associated with an increase in social benefits, an often neglected return on investment. To assess this return on investment in economic terms, the user-pays principle (i.e. “What would an average user pay to benefit from a specific ecosystem service?”) can be applied. Also, the polluter-pays-principle – a central principle of the Alpine Convention (Art. 2 Nr. 1) and the European Environmental Law – may be instrumentalised for the funding of NbS, e.g. by linking the obligation for compensation measures to the implementation of NbS. This approach needs corresponding institutional structures (see Section 4.1.4).

Hypothesis III: A smart combination of public funding and the utilisation of private resources, supported by adapted institutional frameworks is highly relevant for the successful establishment of NbS. Public funding needs to be promoted and easily accessible for project applicants across sectors.

4.2.4. Institutional Requirements

Besides financial incentives, NbS need to be fostered by legal requirements, guidelines, and institutions and need to be integrated into political objectives and strategies.

To establish a common understanding of the characteristics and benefits of NbS, standards are needed that define NbS as well as the ecosystem services related to them. The introduction of testing and monitoring standards for NbS as well as of criteria for their evaluation in economic terms is important to enable cost-benefit assessments in comparison to purely technical measures – particularly considering long-term effects of NbS and external cost aspects, like avoided costs for damage management or social benefits. Such an evaluation should follow a comprehensive approach, while being user-friendly and comprehensible.

Based on such a framework, legal requirements for NbS can be formulated in various ways. For example, public procurement law, construction law, planning law or environmental law regulations can be used to require that the possible use of NbS must generally be investigated for the implementation of projects and that their implementation must be favoured, unless there are overriding reasons of general interest to the contrary.

Such a set of standards should be defined at a transnational level, for example by the UN, at EU level or within the framework of the Alpine Convention. The definition of NbS by UNEP (2022) and the Common International Classification of Ecosystem Services (CICES, Haines-Young & Potschin 2018) can serve as a starting point here.

Also, subsidies and funding programmes to foster NbS as well as further economic considerations can be designed and made, respectively, based on common standards. Technical guidelines and recommendations as well as institutions that provide assistance for the planning and implementation process of NbS, such as specialised authorities, can also significantly support their establishment.

In summary, the stronger establishment and anchoring of NbS in the Alpine region (compared to technical solutions) requires a "policy mix" of legal provisions, technical guidelines, financing mechanisms and standardised planning instruments, linking various affected sectors, e.g. agriculture and forestry, hydraulic engineering, natural hazard management, tourism, spatial and landscape planning, nature conservation, etc. Ensuring these aspects further requires customised governance structures (see Chapter 4.2.6).

Hypothesis IV: The widespread establishment of NbS requires a binding legal framework, standardised evaluation criteria, and institutionalised support structures.

4.2.5. Communication and Education Requirements

Difficulties in establishing and institutionalising NbS arise, inter alia, because many relevant actors (e.g. landowners, administrators, planners, NGOs, media, etc.) know little about the specifics of NbS or are discouraged by the lack of standards or the uncertainty about the (long-term) impact of NbS projects and may therefore be reluctant to adopt them. Besides, the general public may easily underestimate or misjudge the risks associated with the climate crisis and the opportunities provided by NbS to counteract these risks.

NbS often involve specific land use or land management requirements and possible restrictions for landowners. This is a particularly important issue in the Alpine region, where space in the valley floor is limited and different utilisation interests strongly compete.

An important measure to overcome these obstacles is the transfer of knowledge and the development of skills. Important institutions in this regard are technical colleges and universities, professional associations, the public administration, exchange formats for practitioners, NGOs, and schools. They should offer theoretical inputs as well as practical trainings and an exchange of knowledge and experience for students, employees of authorities, planning offices, associations, pupils, and interested citizens in general.

When planning and implementing specific NbS projects, special attention must be paid to communicating with landowners and further stakeholders to address their concerns and needs, to build trust, and ensure transparency.

To increase public awareness of the opportunities offered by NbS and to arouse interest in such solutions, positive narratives that appeal to the population in a motivating, tangible, and emotional way are very helpful.

Hypothesis V: Ensuring the establishment of NbS requires efforts to raise public awareness and to build up capacities by offering easily accessible education and training on theoretical NbS approaches and how to transfer them into action as well as exchange formats among stakeholders.

4.2.6. Governance Requirements

The comprehensive consideration of all the above-mentioned aspects and the realisation of successful cross-sectoral and interdisciplinary concepts requires adapted and, if necessary, new governance mechanisms.

Their form and scope may vary greatly depending on the size and complexity of the respective NbS project. For smaller projects with few participants and a short duration, simple agreements between the partners involved are sufficient, whereas large NbS projects with many participants and/or a long duration going far beyond the usual “single-project-logic” require clearly defined organisational structures and processes – up to and including permanent institutionalisation beyond the immediate project duration and long-term financing mechanisms. If the scope of a project extends across borders, this becomes an additional challenge.

In NbS projects, conflicts of interest between the partners involved are the norm, e.g. between different sectors (agriculture - water management - nature conservation) or between project operators and landowners. Dealing with these different interests in a constructive and professional manner is a key factor for the success of NbS. A wide range of cooperation and conflict management methods and tools are available for the negotiation of conflicting interests. Particular attention must be paid to careful and professional internal and external communication, especially with landowners, without whose land NbS often cannot be implemented. This is particularly challenging in the Alpine region with its limited land availability leading to increased land use conflicts especially in the Alpine valley floors.

Important success factors for good cooperation and coordination between the actors involved in NbS are an inter- and transdisciplinary approach, i.e. the involvement of all relevant actors, a high quality of the content of the measures and a professional framework for cooperation between the various actors. This includes the formulation of clear project goals, a good distribution of tasks among the partners involved, clear leadership by the respective responsible institutions, the establishment of steering and decision-making mechanisms, internal and external transparency and communication based on a clear concept (what is communicated to whom, when, how, by whom). Those responsible for communication should also provide interested citizens with regular information about a project to increase acceptance and awareness of the opportunities offered by NbS. Another key factor for successful NbS is the direct contact and exchange with those directly affected by the project, especially the landowners. It is particularly important to start the exchange at an early project stage to get the people affected on board and take their interests into account right from the outset. Besides, a high-quality of the implemented measures is important to build up trust, counteract possible concerns or prejudices, and create good-practice examples.

These considerations demonstrate that it is very important and valuable to provide sufficient financial and human resources for professional support and management to successfully realise NbS projects.

These points correspond well with the *12 Principles of Good Governance* (CoE 2022), which the Council of Europe confirmed in a decision on the “Strategy on Innovation and Good Governance at local level” (COE 2008):

- (1) Participation, Representation, Fair Conduct of Elections;
- (2) Responsiveness;
- (3) Efficiency and Effectiveness;
- (4) Openness and Transparency;
- (5) Rule of Law;
- (6) Ethical Conduct;
- (7) Competence and Capacity;
- (8) Innovation and Openness to Change;
- (9) Sustainability and Long-Term Orientation,
- (10) Sound Financial Management;
- (11) Human Rights, Cultural Diversity and Social Cohesion;
- (12) Accountability.

Hypothesis VI: The successful establishment of NbS requires 'good' and case-adapted governance mechanisms. This will facilitate cross-sectoral and interdisciplinary collaboration with a special focus on transparency and continuous communication, and increase the acceptance of NbS among landowners, (private) investors, planners, public administration and policy makers.

4.3. Potential Synergies with Existing Strategies and Institutional Frameworks

The existing transnational cooperation frameworks play an important role for a stronger establishment of NbS in the Alpine region:

- As an international treaty between the Alpine countries (and the EU), the **Alpine Convention** has defined the obligation to protect the Alpine region. The “Multi-Annual Work Programme of the Alpine Conference 2023-2030” (PSAC 2022), the 8 thematic protocols and 6 declarations, which are also aligned with the 17 SDGs, provide a good basis for a stronger establishment of NbS in the Alpine region. The Alpine Climate Board is already heavily involved in NbS, and NbS could also be increasingly addressed in other Thematic Working Bodies, such as *Natural Hazards – PLANALP*, *Soil Protection*, *Mountain Agriculture and Mountain Forestry*, *Spatial Planning and Sustainable Development* as well as the *Alpine Biodiversity Board*.
- **EUSALP**, the EU macro-regional strategy for the Alpine Region, offers a good framework for a stronger establishment of NbS within its 9 thematic Action Groups. The following Action Groups are particularly relevant:

Action Group 6: Resources – Preserving and valorising natural resources, including water and cultural resources;

Action Group 7: Green Infrastructure – Developing ecological connectivity in the whole EUSALP territory and

Action Group 8: Risk Governance – Improving risk management and better managing climate change including major natural risks prevention.

The forthcoming revision of the EUSALP Action Plan provides a good opportunity for further anchoring NbS in the Alpine region.

- The third important transnational actor in the Alpine Space is **the Interreg Alpine Space Programme** with different thematic priorities and projects. All four priorities of the present programme³ offer linkage opportunities for NbS. It would be desirable that the topic of NbS and the learnings about the need for long-term structures and funding are explicitly considered in this programme.

³ Programme priorities are: Priority 1: Climate resilient and green Alpine region, Priority 2: Carbon neutral and resource sensitive Alpine region, Priority 3: Innovation and digitalisation supporting a green Alpine region, Priority 4: Cooperatively managed and developed Alpine region.

5. Recommendations and Further Suggestions

The results of the pilot projects analysis, their evaluation, the inputs from the international workshop held in September 2024, and the derived conclusions are incorporated in a set of recommendations outlined in Section 5.1 to support the implementation of NbS in the Alpine region. The recommendations refer to the following aspects:

- Governance and communication
- Decision-making processes
- Practical implementation
- Tools
- Standardisation and Evaluation
- Economic aspects

In addition, the authors of this paper compiled further suggestions to be discussed and elaborated in more detail that are presented in Section 5.2 and refer to the following aspects:

- Utilisation of Social Engagement
- Spatial Planning
- Legal Instruments
- Supporting Bodies and Structures
- Education
- Communication
- Alpine-wide Interactive NbS-Platform

5.1. Recommendations

5.1.1. Governance and Communication Mechanisms Fostering Nature-based Solutions

A stronger establishment of NbS in the Alpine region can be supported by the following governance and communication mechanisms:

- **Stronger anchoring of cross-sectoral approaches in the design of the policy mix in the Alpine region:** Instead of traditional sectoral perspectives and processes, more integrated mechanisms for legislation, funding, strategies and planning instruments should be established. These include, for example, regional, national and transnational cooperation and coordination bodies as well as integrated strategies and programmes with a spatial reference. This promotes cross-sectoral thinking and stronger horizontal and vertical cooperation between the various actors in the political-administrative system.

- **Skills development and training in multilevel governance:** For staff in administration, research, planning offices, NGOs as well as for landowners and other stakeholders training offers on NbS should be provided via webinars, workshops, or excursions, for instance. Thereby, the actors will gain more (self-)confidence in dealing with complex systems and processes in the Alpine region.
- **Development and dissemination of positive narratives on the topic of NbS:** Promote positive narratives by collecting successful examples of implemented NbS in the Alpine region, making them publicly available, and addressing the population in a motivating, tangible, and emotional way. This will reduce mistrust and scepticism towards NbS, which are often characterised by a lack of knowledge, uncertainty and fears, and contribute to a better understanding and greater acceptance of NbS, instead.
- **Sensitive Communication:** Communicate plans and measures in a transparent way right from the outset, take stakeholder concerns seriously and address them.

5.1.2. Integrating Nature-based Solutions into Decision-Making Processes

There are several options to integrate NbS into decision-making processes in the Alpine region, including:

- their structural integration at different policy levels (see below),
- the involvement of decision makers and stakeholders, and
- their incorporation in the Multi-Annual Work Programme of the Alpine Conference, the Interreg Alpine Space Programme, the Interreg Central Europe Programme, and other cross-border strategies and funding programmes, respectively.

The integration of NbS into decision-making processes should take place at several levels:

- at the **local level**, as part of local development policies, such as zoning and land-use planning;
- at **regional and national levels** within the framework of legislation, guidelines, subsidies, (sectoral and integrated) strategic concepts and planning instruments;
- at the **trans-national level** within the framework of the Alpine Convention, the EUSALP, and the Interreg Alpine Space Programme;
- at **EU level**, where the Alpine Member States of the EU could work together in relevant dossiers to ensure that the European framework conditions adequately consider specific needs of the Alpine area.

The integration of NbS into decision-making processes in the Alpine region requires an appropriate policy mix consisting of legal provisions, technical guidelines, financing instruments and (standardised) planning instruments in the various sectors: agriculture and forestry, hydraulic engineering, natural hazard management, tourism, spatial and landscape planning, nature conservation, etc.

5.1.3. Practical Implementation of Nature-based Solutions

Several measures and aspects could foster the practical implementation of NbS in the Alpine area on a wider scale at different levels:

Strategic Level

Delineating relevant and sufficient areas for NbS at a strategic Alpine-wide level and integrating these areas into existing regional and national spatial planning instruments could support their implementation (top-down approach). In addition, areas that are suitable for implementing NbS and specific NbS themselves can be included in existing or envisaged biodiversity strategies. Such an approach may, inter alia, efficiently support the practical implementation of the recently passed EU Nature Restoration Law (Regulation (EU) 2024/1991) and the EU Biodiversity Strategy for 2030.

In general, a better knowledge and understanding is needed regarding how different existing policy instruments (e.g. strategies, programmes, planning instruments) address or hinder NbS.

Local Level

Besides the strategic level, the local level is crucial for a bottom-up process. NbS should address identified challenges at the local level, which are also perceived as such by the local stakeholders. Such an approach should be preferred instead of declaring pre-planned projects as an NbS. At the local level, in particular, quick-wins may be possible by demonstrating the benefits of NbS with small-scale, directly effective, and low-cost NbS projects.

To support especially small communities that often lack sufficient financial and personal resources, specialist departments should be built up at the regional government level to assist with planning and implementation processes of NbS.

Multi-level Planning

Implementation via a top-down (strategic level) and bottom-up (local level) approach means that NbS should be planned at the local, regional, national and alpine-wide level and the different levels should be integrated. Large-scale strategies at national or Alpine-wide level may be implemented through projects for large geographic areas. These are to be supplemented by small, site-specific projects, which are proposed and implemented at regional to local level. The implementation at this level can be supported by staff from experienced public or private institutions.

5.1.4. Tools

Tools may foster the practical implementation of NbS regardless of the spatial level. Some helpful tools can be:

- a **comprehensive and easy-to-use glossary of NbS** (explaining different related concepts such as ecosystem services, green and blue infrastructure);
- a **collection and dissemination of good practice examples** of NbS in the Alps;
- a **decision-making aid on how to transfer NbS** to different contexts.
- an **assessment of the consideration of NbS** in single projects.

5.1.5. Standardisation and Evaluation

In the long run, a standardisation of NbS and an evaluation of their effects will be needed, to demonstrate and proof these effects. A standardisation means that NbS will consider comparable components in the projects such as benefits for biodiversity, human well-being, certainty for the maintenance of the measures. The evaluation will give evidence about the effects NbS have achieved.

For many purposes, there are already standardised approaches, which might be considered for or adapted to NbS. Examples include (technical) guidelines for river restoration measures, land readjustment or land management (see, for instance, the Set of Rules by the German Association for Water, Wastewater and Waste (<https://en.dwa.de/en>)).

Suitable existing tools for a standardised approach could be made available via an open access platform.

Based on existing tools, procedures and processes, a standardised assessment of NbS in the Alpine area could be developed to compare the effects of NbS with technical solutions in terms of the ecological, social and economic effects. Such a standardised assessment would also enable a quality evaluation – even without a legally binding application.

5.1.6. Economic Aspects

Certainly, economic aspects of NbS play a major role for their acceptance. There are two main aspects to be considered:

Public Support

As outlined in chapter 4.2.2, NbS-projects often have a longer duration than conventional projects. Public project funding should consider this by extended funding periods.

NbS project tenders could be given higher priority in funding decisions and / or NbS elements could be declared as a mandatory element for project application.

Economic Valuation of NbS

An economic evaluation of NbS projects could be developed and made obligatory to monitor their economic effects. For such an evaluation, a comprehensive approach is needed, taking into account all effects of NbS, namely the costs of set-up and maintenance for short- and long-term period as well as indirect impacts, to enable the comparison with conventional or technical solutions.

Economic advantages of NbS projects could be demonstrated with a data collection on costs for and benefits of NbS, which might facilitate economic comparisons and increase the acceptance of NbS projects. In such a comparison, also the cost of inaction should be considered to set-up a comparable framework for NbS.

5.2. Further Suggestions

5.2.1. Utilisation of Social Engagement

Many examples show that especially due to their benefits for human well-being, people can easily be motivated to support the implementation of NbS projects. This effect can be utilised, for instance by the following approaches:

- **Innovative Concepts:** Implement competitive initiatives among communities, civil society organisations or student groups to encourage participation, e.g. initiatives like an unsealing competition in the Netherlands (<https://www.nk-tegelwippen.nl/>).
- **Experiential Learning:** Make NbS benefits tangible by integrating them into community spaces, e.g. by integrating restored creeks into playgrounds, like in the “Zürcher Bachkonzept” project (see Chapter 2.2).
- **Volunteer Involvement:** Engage volunteers in projects like, for instance, in the “Bergwaldprojekt” (see Chapter 2.2).

5.2.2. Spatial planning

Spatial planning is an important lever to implement strategic considerations and may help to foster NbS in the Alpine region through the following approaches:

- **Identification of Suitable Areas:** Identify and delineate areas that are particularly suitable for NbS implementation in the Alpine region. If they are privately owned, public acquisition should be considered when they become available.
- **Planning Instruments:** Integrate suitable areas and NbS as such into planning instruments in all relevant sectors and at local, regional, national, and Alpine-wide levels.

5.2.3. Legal Instruments

Apart from the integration of NbS into spatial planning instruments and regulations, further areas of law could be used to implement provisions that support NbS:

- **Public Procurement and Contract Law:** Favour NbS in public procurement processes. Justification should be required if technical solutions are preferred over NbS. Assess cost-effectiveness over the entire lifecycle and consider potentially externalised costs when comparing NbS with alternative solutions (True-Cost-Accounting).
- **Building and Environmental Regulations:** Mandate the implementation of small-scale and easy-to-implement NbS for building projects, such as multifunctional infiltration basins, to promote a bottom-up approach and their rapid dissemination. Prioritise the implementation of NbS unless there is a justified reason for their rejection as a prerequisite for approval procedures.

5.2.4. Supporting Bodies and Structure

As many actors that are responsible for the actual implementation of NbS projects (communities, planning offices, private investors, NGOs, etc.) often lack sufficient personal and financial resources or an overview of existing suitable NbS measures, the realisation of NbS in the Alpine region may be supported by public or private institutions. The following aspects should be considered:

- **Specialised Institutions:** Make sure that already existing or new institutions at regional, national, and transnational levels are able to support cross-sectoral and interdisciplinary approaches. Such specialised institutions should assist in planning and implementation processes, particularly for small communities or organisations with limited personal and financial resources. Landscape Maintenance Associations in Germany may serve as an example, here.
- **Networking Opportunities:** Facilitate networking among practitioners, scientists, and administrators to enhance collaboration.
- **Governance Support:** Provide support, like consultancy, moderation, external mediators, or assistance to realise potentially complex communication formats (e.g. round tables).

5.2.5. Education

Since NbS projects involve complex interrelationships in several aspects (interaction of ecological and technical processes, involvement of various stakeholders, indirect social or economic impacts, etc.) knowledge transfer and skills development are very important to support the establishment of NbS. Education on NbS will foster acceptance, confidence, mutual understanding among different stakeholders, and help affected actors to gain more self-confidence in dealing with complex systems and processes in the Alpine region.

- **Training Opportunities:** Offer theoretical input and training sessions for government employees, planners, NGOs, researchers, and interested citizens through webinars, workshops, excursions, etc.
- **Knowledge Exchange:** Foster the exchange of knowledge and experiences among practitioners, administrative employees, scientists, etc.
- **Highlight Governance Importance:** Emphasise the importance of good governance in all communications. Advocate for sensitive communication that involves all stakeholders affected by NbS projects right from the outset (before the actual planning phase starts) and takes their interests into account.
- **Curriculum Integration:** Integrate NbS topics into educational curricula with supporting materials, like provided by the “I-SWAMP” project (see Chapter 2.2).

5.2.6. Communication

A stronger establishment of NbS in the Alpine region can be supported by the following communication mechanisms:

- **Positive Narratives and Success Stories:** Promote positive narratives by collecting successful examples of implemented NbS in the Alpine region, making them publicly available, and addressing the population in a motivating, tangible, and emotional way.
- **Sensitive Communication:** Communicate plans and measures in a transparent way right from the outset, take stakeholder concerns seriously and address them.

This will contribute to a better understanding and greater acceptance of NbS and prevent possible fears of misuse of the concept.

5.2.1. Alpine-wide Interactive NbS-Platform

One of the greatest challenges in today's world is an overflow of information and, closely related to this, the selection of information sources.

The centralised provision of as much relevant information on NbS in the Alpine region as possible may therefore be a decisive lever to address and connect relevant stakeholders as well as to prevent several independent parallel developments and efforts with the same objective that are not necessary to be carried out in a redundant way.

The authors of this paper hence suggest the development of an open-access interactive platform across the Alpine region that aggregates all relevant information on NbS and facilitates all the aspects mentioned in the previous sections. This platform should include, for example, definitions and standards, legal guidance, governance guidelines, case studies and educational material. The platform might include a Web-GIS service showing implemented NbS locations and providing a feature that allows citizens to propose potential sites for NbS implementation.

The Alpine region has a high potential for the implementation of NbS in different sectors. Specific political mandates to further develop and implement the above recommendations and ideas could be set out in an "**Nature-Based Solutions Strategy for the Alps**".

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