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European Biodiversity Partnership

Issue brief

Living systems, living solutions: Advancing Nature-based Solutions across European landscapes

As Europe faces intensifying climate change, biodiversity loss, and pressures on land use, Nature-based Solutions (NbS) are emerging as powerful, locally adapted strategies to address these intersecting challenges. This issue brief brings together key insights from three BiodivClim pan-European research projects—NAPERDIV[1], PlantCline[2], and NordSalt[3]—alongside a policy-relevant case study from FutureArcticLives[4]. Together, these initiatives explore how NbS are being tested and adapted to offer solutions for farmlands, coastal salt marshes, and Arctic communities.

Main Findings

1. Rooted resilience: Perennial crops and plant diversity as Nature-based Solutions

- **Perennial grain crops** — crops that remain productive for two or more years like rye, rice, barley, and wheatgrass—offer promising NbS for reducing agriculture's environmental impact. These regrowing crops need less tillage, fertiliser, and pesticides, while improving soil health, nutrient retention, and biodiversity. Some, like perennial rice, are already delivering results; others are advancing through breeding. (NAPERDIV – Europe)

- **Woodland strawberry genotypes** across Europe show strong local adaptation, especially in extreme environments. Northern populations adapt better to changes in light and temperature, but reduced precipitation leads to contrasting performances across all regions. Researchers analysis identified genes that help strawberries adapt to temperature and flowering changes. This shows why it is vital to conserve local varieties and why moving species around ('assisted migration') may not work under complex climate pressures. Future studies need to investigate if these conclusions hold for all crop wild relatives. (PlantCline – Europe)

2. Salt marshes in the Nordics: Strengthening coastal resilience through targeted restoration

- Salt marshes in Nordic regions play only a limited role in carbon storage, but they are critical for climate adaptation—offering natural flood protection, erosion control, and biodiversity support. Research shows that working with natural processes , such as tidal reconnection and sediment reintroduction, is more cost-effective

1. Footnotes can be found in the information sheet.

than active reestablishment through planting or fertilisation. Recovery is influenced less by climate factors than by past land use and grazing pressure, which means restoration must be carefully tailored to each site. Importantly, nature takes time to heal: full recovery of salt marshes can take decades, so long-term planning is essential. To improve outcomes, a harmonised EU typology and monitoring framework is urgently needed. (NordSalt – Northern Europe)

3. **Local knowledge, local impact: Tailoring NbS to social and ecological contexts**
   While ecological restoration is vital, the long-term success of NbS also depends on people—their knowledge, practices, and capacity to innovate.

- A **farm network in France** and stakeholder collaboration across five countries (France, Italy, Denmark, Sweden and United Kingdom) enabled real-world testing of Intermediate Wheatgrass and helped develop a **sustainable value chain**. These efforts show that **farmer-led innovation and stakeholder buy-in** are key to turning research into impact. (NAPERDIV – Europe)

- In Arctic Sweden and Norway, **reindeer herders view land-use change as a greater threat than climate change**. Incorporating **Indigenous and local knowledge** is essential to understand food system shifts and ensure NbS are rooted in local realities. (FutureArcticLives – Sweden and Norway)

Context: Nature-based Solutions in productive landscapes

At the European level, interest in NbS is growing—but **implementation remains uneven**. While some EU policy frameworks support NbS principles, only **35% explicitly reference** them, and few are backed by binding mechanisms[5]. This gap between policy ambition and enforceable action highlights the need for stronger integration of NbS across sectors.

NbS were defined by the 5th United Nations Environment Assembly as:

"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**."

"Living knowledge at the edge" – Nature-based Solutions in remote landscapes

In the Arctic, where climate change is advancing faster than anywhere else, NbS offers a path to safeguard both ecosystems and traditional ways of life. From reindeer herding to coastal fishing, Indigenous Peoples and Local Communities have long managed land and sea through sustainable, adaptive practices deeply rooted in place—practices that naturally align with NbS principles.

The **FutureArcticLives** project examined how NbS could be implemented in Arctic Scandinavia and Greenland, and what regulatory barriers hinder their deployment. Through bioeconomic modelling and community-based research, the project assessed the impact of various climate scenarios on small-scale natural resource users and identified potential adaptation strategies.

In **Sweden and Norway**, reindeer herding practiced by the Saami illustrates a nature-based approach grounded in ecological knowledge and seasonal mobility. Yet the viability of this livelihood is increasingly threatened by climate pressures. Consultations revealed two adaptation strategies: either maintain current herd sizes with supplementary feeding, or reduce herd sizes to stay within ecological limits. The latter—limiting herds to the land's natural carrying capacity—better aligns with NbS goals by supporting tundra biodiversity and reducing environmental strain.

In **northern Norway's Porsanger fjord**, small-scale fishers are facing declining stocks, shifting quota regimes, and the arrival of invasive species. Here too, NbS are emerging through local marine restoration efforts: the creation of artificial kelp forests and the revival of cod fishing via aquaculture are aimed at enhancing ecosystem resilience and securing food supplies.

However, the project also showed that **governance frameworks can often hinder rather than support the implementation of NbS**. In **Greenland**, for example, the proposed introduction of Individual Transferable Quotas (ITQs), based on models from other national contexts, risks clashing with local socio-spatial realities and disrupting traditional management practices. In contrast, **Norway's 2005 Finnmark Act**[6] offers a more enabling framework: it transferred 95% of county land to local populations. Although legally neutral, this policy effectively supports Saami land use rights by acknowledging their role in sustainable land management. This type of legislation provides a more fertile ground for NbS that are adapted to local realities.

One of the project's key insights is that **many Arctic practices are already deeply nature-based**, but rigid policies fail to accommodate their flexibility and local specificity. In these regions, NbS must be **co-developed with communities whose lives are closely tied to land and sea ecosystems**.

Finally, in **remote and postcolonial contexts**, the success of NbS depends strongly on **knowledge co-production and collaborative governance**. Integrating Indigenous and local knowledge is not merely an act of recognition—it is an essential condition for ensuring scientific relevance, community trust, and the long-term resilience of both ecosystems and the societies that depend on them.

In productive landscapes—such as those used for agriculture, forestry, or fisheries—NbS can be **powerful tools** for improving environmental sustainability and long-term viability[7]. By enhancing biodiversity and ecosystem services, NbS can support high-quality food production, mitigate climate change, and reduce the negative impacts of intensive land use. They also offer co-benefits for **public health, economic resilience**, and **social equity**[8].

Too often, NbS are viewed narrowly—as conservation efforts or carbon sequestration measures. Yet their true value lies in **holistic, long-term planning** that accounts for **local ecological conditions, socio-economic realities**, and **climate vulnerabilities**[9]. For NbS to deliver lasting impact, they must be embedded in systemic, place-based strategies rather than short-term or single-goal interventions[10].

Key results for maintaining soil biodiversity and health

Farming resilience in a changing climate

The BiodivClim projects **NAPERDIV** and **PlantCline** explored how sustainable crops can support climate-resilient farming across Europe.

Perennial grains for sustainable farming

NAPERDIV assessed the potential of perennial grain crops—which grow back each year without replanting—to deliver a broad range of ecosystem services. These include grain and forage production (provisioning services), but also soil protection, nutrient cycling, and climate mitigation (supporting and regulating services).Because they regrow each year, perennial crops also reduce the need for frequent tillage and eliminate the annual purchase and sowing of seeds, easing farmers' workloads.

A particular focus was placed on Intermediate Wheatgrass (IWG, *Thinopyrum intermedium*)—used as a model crop for testing perennial-based systems across various climates and soils. Key findings included:

- **Healthier soils**: IWG grows deeper, denser roots than conventional cereals, improving water and nutrient efficiency, carbon storage, and microbial diversity.
- **Cleaner inputs**: It requires less nitrogen fertiliser and pesticides, reducing risks of water and air pollution.
- **Greater resilience**: IWG supports diverse soil food webs and enhances nutrient cycling even under varied climatic conditions.

While the environmental benefits are clear, IWG still delivers low grain yields, limiting its immediate uptake. Further research is needed to assess trade-offs between yield (provisioning services) and other ecosystem benefits, as well as to support the breeding of more productive perennial crops.

As part of **NAPERDIV**, a network of 20 pioneering

farmers in France tested Intermediate Wheatgrass (IWG) through small-field trials under diverse soil, climate, and management conditions. Farmers were motivated either by the desire to innovate or the need to find solutions to agronomic, economic, or climatic challenges. Their active involvement proved essential for integrating IWG into real-world farming systems. This experience shows that farmer-led innovation, supported by scientific collaboration, is key to bridging the gap between research and practice—and to scaling up NbS in agriculture.

Genetic diversity for climate adaptation

The **PlantCline** project explored how plant genetic diversity supports resilience under climate change, focusing on **200 genotypes of woodland strawberry (*Fragaria vesca*)** from Northern and Southern Europe.

- **Northern genotypes** showed greater adaptability to environmental changes—especially in adjusting flowering times based on light and temperature—than Southern ones.
- The project identified **key genes** linked to **fruit sweetness and drought tolerance**, offering valuable targets for **climate-resilient breeding**.
- Using this data, researchers developed **predictive models** to forecast how different strawberry traits (morphological, demographic, and physiological) respond to future climate scenarios. These models underscore the importance of **locally adapted populations and** suggest that **broad strategies like assisted migration may offer limited benefits** for wild strawberry.

Together, these findings strengthen the case for ***in situ* conservation of genetic** diversity and highlight how native plant traits can inform more sustainable, adaptive crop development.

Fig. 1. Experimental woodland strawberry (*Fragaria vesca*) plants under rainout shelters at the field station in Rascafria, Spain (Photo credit: Dries Bonte).

Restoring Nordic salt marshes: Supporting coastal resilience and biodiversity

Salt marshes are vital coastal ecosystems that offer multiple environmental benefits—including biodiversity support, erosion control, and flood mitigation. While their carbon sequestration potential is limited in the Nordic region—estimated at less than 0.02% of national annual CO_2 emissions—their contribution to climate adaptation and ecosystem restoration is significant and often under-recognised[11].

Findings from the **NordSalt** project highlight several key insights and opportunities for enhancing their value through well-targeted NbS:

- **Maximise restoration effectiveness by working with natural processes**. Techniques such as tidal reconnection and sediment reintroduction are more effective for boosting carbon stocks and reducing methane emissions than planting or fertilisation alone.

- **Context matters: land use history and grazing strongly shape recovery**. In many sites, grazing pressure and past land management had a greater influence on plant communities than climate drivers. This underscores the need for tailored restoration plans that align with local ecological conditions and socio-economic contexts.
- **Unlock greater potential through harmonised classification and monitoring**. The ecological diversity of salt marshes is not fully captured by current national typologies. A shared EU-wide classification system and monitoring standards would improve coordination, enable better tracking of restoration progress, and support policy development under the EU Nature Restoration Law.
- **Nature restoration takes time**. The restoration of salt marshes will often take decades to achieve the full benefits of these restored habitats (thus all the more reason to preserve existing salt marshes from further loss).

While Nordic salt marshes may not be major carbon sinks, they remain high-value ecosystems with important roles in nature restoration, coastal resilience, and adaptive land management. Investing in their recovery through evidence-based, context-specific approaches ensures benefits for both nature and people—making them a strategic asset in climate and biodiversity policy.

Fig. 2. Left photo - Soil collection in Denmark in 2021 (Photo credit: Simon Thomsen). Right Photo - Greenhouse Gas measurement training in Germany, April 2022 (Photo credit: Marianna Lanari).

Link to sources

NAPERDIV
PlantCline
NordSalt
FutureArcticLive

Scientific publications used in this policy brief can be found in the Information Sheet of this briefing downloadable from: www.biodiversa.eu/policy-briefs/

Photos: Unsplash

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