

# EU4GREEN

## NATURE-BASED SOLUTIONS IN AGRICULTURE FOR BIODIVERSITY ENHANCEMENT



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### **EU 4 Green Recovery: Support the implementation of the Green Agenda for the Western Balkans**

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## Abbreviations

<b>CICES</b>	Common International Classification of Ecosystem Services
<b>ES</b>	Ecosystem Services
<b>EU</b>	European Union
<b>GIS</b>	Geographic Information System
<b>IUCN</b>	International Union for Conservation of Nature
<b>NbS</b>	Nature-based Solutions
<b>NGO</b>	Non-governmental Organisation
<b>WB6</b>	Western Balkans Six (Albania, Bosnia and Herzegovina, Kosovo*, Montenegro, North Macedonia and Serbia)

*\* This designation is without prejudice to positions on status, and it is in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence.*

# 1 SUMMARY

The guidance document “Nature-Based Solutions in Agriculture for Biodiversity Enhancement” presents a comprehensive framework for designing, implementing, and maintaining Nature-based Solutions (NbS) in agricultural systems, particularly within the Western Balkans. NbS are interventions that protect, restore, and manage ecosystems to address societal challenges such as climate change, food security, soil degradation, and biodiversity loss, while delivering benefits to both people and nature. Unlike conventional agriculture reliant on external inputs, NbS integrate ecological processes to sustain productivity and resilience.

Aligned with the EU Green Deal, Biodiversity Strategy for 2030, Common Agricultural Policy (CAP 2023-2027), and Nature Restoration Regulation, NbS act as instruments linking biodiversity conservation with sustainable agriculture, water management, and rural development. Practices such as wildflower pollinator strips, hedgerows and windbreaks, and vegetated filter strips are emphasized for their capacity to enhance pollination, regulate water and soil systems, sequester carbon, and strengthen habitat connectivity.

The guidance document applies the IUCN Global Standard for NbS, built around eight interlinked criteria ensuring ecological effectiveness, economic viability, inclusivity, and adaptive management. Implementation is structured in three phases—design & assessment, implementation, and maintenance & evaluation—emphasizing participatory approaches, site-specific assessments, stakeholder engagement, and long-term monitoring.

Special attention is given to the Western Balkans’ ecological richness and institutional challenges. The guidance document highlights pilot initiatives under EU4Green that integrate NbS in protected floodplains to improve biodiversity, mitigate droughts and floods, and align with EU environmental standards. It also provides detailed guidance on data acquisition, including biodiversity, soil, water, and climate indicators, and identifies funding mechanisms such as CAP, LIFE, Horizon Europe, IPARD III, and regional investment frameworks. The document concludes that mainstreaming NbS in agricultural policy and practice is essential for transitioning to resilient, biodiversity-positive food systems and achieving EU and global sustainability targets.

## 2 INTRODUCTION

The Green Agenda for the Western Balkans (GAWB) establishes a strategic framework for six Southeastern European economies — Albania, Bosnia and Herzegovina, Kosovo\*, Montenegro, North Macedonia, and Serbia. Adopted by the Western Balkan Six (WB6) during the Sofia Summit in 2020, the agenda aims to steer these economies toward climate neutrality and environmental sustainability in line with the European Green Deal. It embodies the European Union's commitment to supporting the WB6 in addressing environmental challenges while fostering economic and social development.

The GAWB is structured around five key pillars: Decarbonisation, Circular Economy, Depollution of Air, Water and Soil, Sustainable Agriculture, and the Protection of Biodiversity and Ecosystems. By advancing their economies in accordance with these pillars, the WB6 contribute to meeting the prerequisites for EU membership.

Within this framework, the EU4Green project plays a central role in the European Commission's ongoing efforts to help the WB6 transition toward sustainable growth. One of the key components of the biodiversity pillar focuses on protecting and conserving biodiversity while balancing environmental sustainability with economic development. This includes a wide range of topics, such as Nature-based Solutions (NbS), with particular emphasis on Natura 2000, Invasive Alien Species, and ecological connectivity. Through the exchange of knowledge and expertise, the project supports partner economies in implementing effective environmental practices.

This guidance document is one such outcome, focusing specifically on Nature-based Solutions and their application in the context of agriculture.

### Nature-based Solution in the Western Balkans

The Western Balkan region is highly vulnerable to climate change and environmental degradation due to its rich biodiversity and diverse ecosystems. This makes it a strong case for the adoption and expansion of nature-based solutions. The region currently faces urgent environmental challenges including land degradation, water scarcity, flooding and biodiversity loss, issues which are often exacerbated by unsustainable land use practices, weak environmental governance and insufficient investment in green infrastructure (Schwarz et al., 2018).

Despite these challenges, awareness of the benefits and potential of NbS is growing, particularly with regard to their cost-effective and socially inclusive approach to addressing such issues. Several countries in the region have launched pilot initiatives focusing on wetland restoration, forest conservation, and erosion control, yielding encouraging results in terms of strengthening ecosystem services and community resilience.

Furthermore, the Western Balkans' efforts to align with EU environmental standards via the Green Agenda for the Western Balkans (GAWB) are creating a supportive policy framework for the wider integration of NbS. With enhanced technical assistance, increased investment and stronger cross-border collaboration, the region has significant potential to scale up NbS interventions, advancing EU-aligned environmental goals while promoting sustainable economic growth, revitalising rural areas and enhancing climate resilience.

### 3 HOW TO USE THIS GUIDANCE DOCUMENT

The aim of this guidance document is to provide the readers with a document that leads them through the process of designing, implementing and maintaining Nature-based Solution (NbS) in agriculture. That includes in particular NbS that foster the connectivity within the intensively used and often sparsely structured and connected agricultural landscape. The covered examples of the document are wildflower pollinator strips, hedgerows and windbreaks, and vegetated filter strips. Following the eight criteria of the Global Standard for Nature-based Solutions (IUCN, 2020a), the key aspects during the realisation process are elaborated.

To underline the importance of NbS in the context of biodiversity protection, mitigation of climate change effects and, ultimately, serving the society, the arising benefits of NbS in general as well as the specific measure of creating agricultural NbS are presented.

The general data availability for planning the measures is another crucial point covered in the guidance document. Useful data types and examples for available sources are intended to help with the search of suitable information to back up the envisaged NbS project fact-based following a scientific approach. Those environmental or biological parameter can also serve as indicators for measuring the desired impact and effectiveness of the actions and furthermore, monitoring the outcome of agricultural NbS in the long run.

In order to break down the challenging endeavour of planning and realising suitable NbS, this document pursues an implementation approach structured in 3 phases (design & assessment, implementation and maintenance & evaluation). It enables the user to develop a sound, sustainable and effective implementation of the given NbS, that aims to tackle challenges of society and nature conservation alike in an inclusive manner. The final NbS implementation plan should not only describe solutions provided by nature but also find its way in the decision-making process of policy makers and acceptance of the general public.

A robust financial plan and thus access to reliable and sufficient funding is vital for being successful. Due to its importance, potential financial resources are covered specifically within the respective chapter. Existing funding opportunities from the global to the regional level are presented to the user. Also, an overview of the funding requirements, budget ranges and links to the various programs is given to help with the selection of the right funding scheme.

Overall, this document is intended as a guide for practitioners, planners, and decision-makers involved in environmental restoration and landscape management across the Western Balkan and beyond. This includes implementing stakeholders, such as administrative bodies of protected areas, governmental entities, NGOs or technical bureaus, with the goal of implementing agricultural NbS in their economy, region or municipality. The user should be informed about the key aspects and necessary steps that support successful project implementation. They should also understand how to approach and integrate these elements into the process. However, not every step is intended to be explained in full detail – for example, specific methodological procedures like assessing environmental indicators.

For more specific information and further readings on the several considerations, the guidance document refers to complementary guidelines, handbooks and other relevant sources that provide more insight are available.

## 4 NATURE-BASED SOLUTIONS

### What are Nature-based Solutions?

Nature-based solutions (NbS) involve actions aimed at protecting, sustainably managing and restoring natural or modified ecosystems. They offer effective and adaptable ways to address societal challenges, enhancing human well-being and supporting biodiversity (Figure 1). Unlike ad hoc environmental initiatives, NbS are implemented with careful consideration of economic, social and environmental contexts. As such, they offer a strategic approach to tackling issues such as climate change, disaster risk, food and water security, and public health. These solutions are grounded in the functionality, resilience, and regenerative capacity of natural systems. (Sowińska-Świerkosz & García, 2022; Dumitru & Wendling, 2021; Cohen-Shacham et al., 2016)

**INFOBOX**

*“Nature-based solutions are actions to protect, manage and restore natural or modified ecosystems, which address societal challenges, effectively and adaptively, providing human well-being and biodiversity benefits” - IUCN (2016).*

**/INFOBOX**



Figure 1 - NbS addressing societal challenges with the ecosystem-based approach. (IUCN, 2020a)

Nature-based solutions differ from conventional agricultural practices, which often rely on intensive external inputs such as synthetic fertilisers, pesticides or heavy irrigation systems. While these methods may increase short-term yields, they usually result in soil degradation, reduced biodiversity and increased long-term vulnerability to climate shocks. In contrast, NbS utilise ecological processes to sustain productivity whilst restoring ecosystem health (Gabriel et al., 2013).

For example, rather than using chemical pesticides exclusively, farmers can create wildflower strips or hedgerows to attract pollinators and natural predators, thereby enhancing crop yields through ecological pest control (Albrecht et al., 2020; Parmentier et al., 2024, Tamburini et al., 2020). Similarly, rather than applying synthetic nitrogen fertilisers, cover crops and legume-based rotations enrich soils with organic matter and fix atmospheric nitrogen, thereby improving fertility and reducing dependency on industrial inputs (Kremen & M'Gonigle, 2015).

Irrigation technologies designed to offset water stress can be complemented — or even partially replaced — by agroforestry systems and vegetated filter strips, which enhance water retention, reduce runoff and improve groundwater recharge (José, 2009; Enescu et al., 2025). Over time, these NbS become more effective as ecosystems mature, offering additional benefits such as soil regeneration, carbon sequestration and climate resilience.

In summary, Nature-based Solutions represent a transformative and integrative framework for achieving sustainable and resilient agroecological systems. By aligning ecological processes with social equity and local knowledge, they can simultaneously enhance productivity, biodiversity, and climate resilience (Wynberg et al., 2023; Miralles-Wilhelm, 2023). Yet, as emphasized by Nesshöver et al. (2017), unlocking this potential demands concerted efforts across disciplines, supported by enabling governance structures and comprehensive, context-specific evidence. Ultimately, NbS offer a practical and science-based pathway for advancing more sustainable and adaptive food systems.

## Nature-based Solutions in EU policies & frameworks

Nature-based Solutions are closely aligned with several key pillars of European environmental policy, particularly those that shape the governance and management of agriculture and biodiversity. Within the framework of the EU Common Agriculture Policy 2023-2027 (CAP) which aims to introduce sustainable practices in agriculture, integrating targets for biodiversity enhancement, climate change mitigation and environment protection. NbS offer a practical and effective means to meet these goals by the enrichment of the agricultural land with connective elements is not only creating habitats and making the landscape more permeable for species, but it also provides several ecosystem services for human well-being. The CAP also offers funding to promote and foster opportunities for NbS implementation in agriculture.

With the proximity to floodplains and river ecosystems in general, NbS in agriculture also contribute to the framework of the EU Water Framework Directive (WFD), which aims to achieve good ecological and chemical status of all water bodies. The effect on agricultural runoffs directly impacts the water quality, regulate hydrological regimes, and enhance the ecological integrity of aquatic systems, all of which are central to the WFD.

The EU Nature Restoration Regulation (NRR) further strengthens the relevance of NbS by proposing legally binding targets for the restoration of degraded ecosystems across member states. This law acknowledges that ecological restoration is not only a means of reversing biodiversity loss but also a key strategy for climate adaptation and resilience. The EU NRR is based on the idea that NbS are

essential to achieving its goals. Key restoration activities such as afforestation, wetland regeneration, or coastal habitat recovery are NbS. The multi-functional character of NbS renders them especially valuable for meeting restoration targets while delivering co-benefits in areas such as climate change mitigation and adaptation, agriculture, water retention, and disaster risk reduction. Art. 11 specifically targets the “Restoration of agricultural ecosystems”, but also other articles of the NRR are closely connected to the studies aim, namely Art. 10 “Restoration of pollinator populations and Art. 4 “Restoration of terrestrial, coastal and freshwater ecosystems”.

The objectives of the EU Habitats Directive are also reflected in NbS, as the directive establishes a network of protected areas under Natura 2000 and mandates the conservation of natural habitats and species of European importance. By restoring or enhancing the structure and functioning of ecosystems of the floodplains and beyond, NbS improve the conservation status of habitats and species listed under the directive. They provide a strategic means of supporting habitat connectivity, buffering protected areas, and increasing the resilience of species populations in the face of environmental pressures and climate change.

The EU Biodiversity Strategy for 2030 further integrates NbS into the broader European environmental agenda by explicitly calling for the large-scale deployment of nature-based solutions as part of its overarching goal to halt and reverse biodiversity loss. The strategy envisions the restoration of at least 20 percent of the EU's land and sea areas, a target that hinges on implementing effective, scalable, and inclusive approaches. The importance of Nature-based solutions as pivotal instruments for achieving this objective is emphasised, not only through direct nature restoration but also by integrating biodiversity considerations into sectors such as agriculture, forestry, and urban planning.

In essence, Nature-based Solutions serve as a unifying framework that connects these major EU directives and strategies. Nature-based Solutions embody a paradigm shift towards systemic, ecosystem-based governance, where water management, habitat conservation, climate resilience, and sustainable development are addressed through interconnected, nature-positive actions.

## Guidelines and frameworks on NbS implementation

Before initiating the conceptualization and implementation of NbS, it is recommended to draw on the available guidelines and frameworks throughout the planning process and beyond. These resources provide valuable tools for developing indicators, selecting appropriate methods, and designing adaptive management and monitoring plans, thereby enhancing the effectiveness and optimization of the NbS project.

## IUCN Global Standard for Nature-based Solutions in Agriculture

The IUCN Global Standard for Nature-based Solutions is a framework developed by the International Union for Conservation of Nature (IUCN) to guide the design, implementation, and evaluation of NbS. It provides clear criteria and indicators to ensure that interventions in agriculture not only address societal challenges—such as climate change, biodiversity loss, soil degradation, and water scarcity—but also contribute to sustainable food production and resilient rural livelihoods. The standard emphasizes solutions that are scientifically robust, socially inclusive, and economically viable, fostering collaboration among farmers, policymakers, and communities to maximize benefits for both people and ecosystems.

Applying the eight criteria of the IUCN Global Standard (IUCN, 2020a,b) is particularly valuable in shaping agricultural NbS—such as pollinator strips, hedgerows and windbreaks, vegetated filter strips—so they deliver feasible, measurable, and sustainable outcomes. The framework ensures that such practices are scalable, biodiversity-enhancing, and aligned with local and global policy goals. By embedding these principles into agricultural planning, NbS become powerful tools for restoring ecosystem health, supporting farmer livelihoods, and strengthening resilience to global challenges.

All the criteria are interconnected and fulfilling them is vital for the successful implementation of Nature-based solution in a sustainable manner. The eight main aspects can be summarized as follows (IUCN, 2020a, b):

- Criterion 1: The NbS effectively addresses the most pressing societal challenges, with a clear understanding of and documentation of these challenges, as well as the outcomes for human well-being.
- Criterion 2: The NbS recognises the necessary scale and considers the interaction between ecosystems, the economy and society, as well as possible synergies and risks.
- Criterion 3: The NbS leads to an increase in biodiversity and ecosystem integrity that can be monitored periodically.
- Criterion 4: The NbS is economically viable, considering several options for resources.
- Criterion 5: The NbS is based on inclusive, transparent and empowering governance processes, including feedback of local stakeholders.
- Criterion 6: The NbS equitably balances trade-offs between achievement of its primary goal(s) and the continued provision of multiple benefits.
- Criterion 7: The NbS is managed adaptively, based on evidence.
- Criterion 8: The NbS is sustainable and has been integrated into an appropriate jurisdictional context.

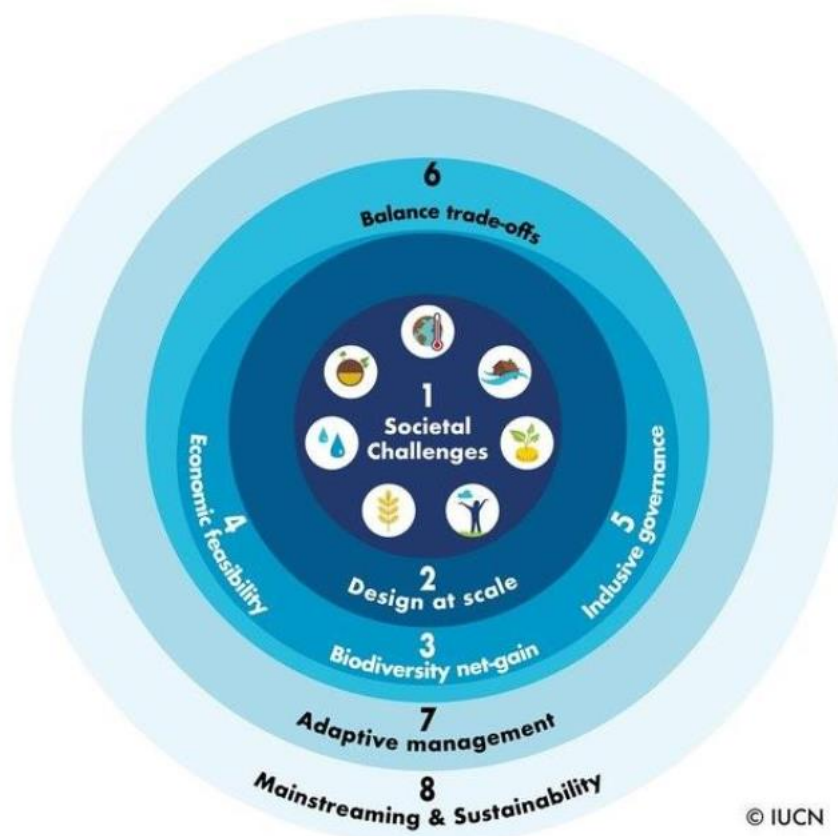


Figure 2 - The eight interconnected criteria of the IUCN Global Standards for NbS. (IUCN, 2020a)

The principles of the eight interconnected criteria (Figure 2) form the basis of this document, which tries to cover the most relevant points for the WB6, with the focus on riparian buffer zones.

Further frameworks and concepts also highly relevant for the implementation of NbS are, among others, listed below.

#### *Frameworks of Ecosystem Services*

These hierarchical frameworks define ES in a structured manner. Based on the definitions, indicators can be derived, enabling the assessment of ES and their changes over time. Thus, the effect of NbS on monitored systems, such as floodplains, can be evaluated as well. Examples for possible indicators include carbon storage in the soil, purification degree of the water, etc.

This guidance document follows one of the most widely used systems – the [Common International Classification of Ecosystem Services](#) (CICES; Haines-Young, 2023).

#### *EU Mapping and Assessment of Ecosystems and their Services*

The so-called [MAES report](#) (Maes et al., 2020), prepared by the Joint Research Centre, the European Environment Agency, DG Environment, and the European Topic Centres, assesses the state of EU terrestrial, freshwater, and marine ecosystems. Using a consistent methodology and the 2010 policy baseline, it analyses ecosystem pressures and conditions to evaluate progress toward the 2020 biodiversity targets and to provide a data foundation for future policy and restoration efforts (2020–2030). This knowledge can be used for planning green infrastructure and biodiversity by EU member states. It also helps to assess the condition of ecosystems and services provided by implemented NbS.

#### *Catalogue of Nature-based Solutions (EU4Environment)*

This [catalogue](#) for the water sector in the Eastern Partnership countries (EU4Environment, 2024) provides 34 NbS specifically for the context of river ecosystems habitats or land use types in proximity to water bodies. Besides the restoration of riparian vegetation and buffer strips, it offers potential measures for the river itself, adjacent forests, agricultural land or grasslands as well as built-up areas. A one-paged factsheet is dedicated for each measure, consisting of information on scale, pressure efficiency, relevant stakeholders, a short description on how to implement it, including a cost calculation as well as technical references and related case studies.

#### *Guidelines for measuring ES Indicators*

The [guidance on measuring ecosystem services](#) (Brown et al., 2014) provides support for selecting suitable environmental, social and economic indicators. These parameters are also highly applicable on NbS. Indicators should follow the SMART concept (meaning they should be **s**pecific, **m**easurable, **a**chievable, **r**elevant, **t**ime-bound).

#### *OPPLA Knowledge Platform*

The purpose of the [OPPLA Knowledge Platform](#) is to provide a collection of tools, guidance on elaborating and monitoring NbS as well as case studies. Examples of such tools are the EKLIPSE Impact Evaluation Framework.

#### *Knowledge Hub of Biodiversa+*

Provided and funded by Biodiversa+, the [Knowledge Hub provides a broad selection of handbooks and guides, knowledge synthesis as well as policy briefs for further reading about different implementation aspects of NbS.](#)

The frameworks and guidelines offer a broad overview of the background information, general concepts and approaches on Nature-based Solutions and the closely linked ecosystem services. This guidance document is built on the existing work and aims to synthesise that information while applying it to the Western Balkans.

Additional regional context is available in the project's *Summaries of Pilot Areas*, which document all activities carried out in the pilot sites under the EU4Green project. The summaries present the current situation based on the project's results and findings regarding the thematic pillars NbS, Natura 2000 and Connectivity.

## 5 NBS IN AGRICULTURE AND THEIR ENVIRONMENTAL & SOCIETAL BENEFITS

While Nature-based Solutions (NbS) in agriculture span a wide array of practices—from wetland restoration to improving soil health—this document focuses specifically on those that directly contribute to enhancing on-farm and landscape-level biodiversity. Three key types are emphasized:

- **Wildflower Pollinator Strips:** Pollinator corridors, composed of native flowering plants strategically planted along field margins or within crop systems, provide essential foraging and nesting habitats for wild pollinators. By supporting pollinator populations, these corridors play a dual role in conserving biodiversity and sustaining agricultural productivity.
- **Hedgerows and Windbreaks:** Windbreaks (or shelterbelts) consist of tree and shrub rows that not only protect fields from wind erosion and microclimate stress but also create diverse vertical habitat structures that support birds, insects, and other beneficial wildlife.
- **Vegetated Filter Strips:** Vegetated filter strips are narrow areas of grass, shrubs, or other permanent vegetation established between agricultural fields and water bodies. They slow surface runoff, trap sediments, and filter nutrients or pesticides before they enter streams or rivers. In addition to improving water quality, they also provide habitat for wildlife and contribute to overall landscape biodiversity.

Agroforestry—a system integrating trees with crops or livestock—is acknowledged here but detailed elsewhere, notably in [EU4GREEN's document on water management in agriculture](#).

### 5.1 Ecosystem Services and Nature-based Solutions in Agriculture

Nature-based solutions in agriculture provide a wide array of ecosystem services that are essential for sustainable food production, environmental resilience, and societal well-being. Using the Common International Classification of Ecosystem Services (CICES) framework, these benefits can be grouped into provisioning services (e.g., food, fiber, and pollination support), regulation and maintenance services (e.g., soil fertility, water regulation, climate stabilization, and biodiversity conservation), and cultural services (e.g., landscape aesthetics, recreation, and community identity).

By aligning agricultural practices with natural processes, NbS enhance species richness, strengthen ecological functions, and support productive, resilient farmland. Interventions such as flower strips, hedgerows, vegetated buffer zones, and agroforestry systems contribute to habitat creation, connectivity, and pollinator support, while also improving soil health, water retention, and climate regulation. Simultaneously, these measures provide cultural and socio-economic benefits, including enhanced landscape aesthetics, agri-tourism potential, and strengthened rural community identity.

### Biodiversity and Species Richness (Regulation & Maintenance Services)

Nature-based solutions in agriculture offer profound and multifaceted benefits. By working with natural processes, NbS strengthen species richness, enhance ecosystem functionality, and simultaneously support agricultural productivity and broader societal well-being. Central to these benefits are the creation and enhancement of habitats, the conservation of native flora and fauna, and the provision of essential resources for pollinators and beneficial insects.

NbS interventions—such as flower strips, hedgerows, and vegetated buffer zones—expand the diversity and spatial extent of habitats within agricultural landscapes. Even small-scale measures can have rapid effects: for example, wildflower strips planted in rye fields were shown to significantly increase the species richness of carabid beetles, spiders, butterflies, and pollinators within just three months compared to adjacent monocultures (Kujawa et al. 2020). These interventions not only improve biodiversity but also begin restoring the ecological functions that intensive agricultural systems often erode.

Longer-term implementations yield even more notable outcomes. Structured ecological designs, such as “three-strip management” of perennial flower margins, have been demonstrated to significantly boost both the abundance and diversity of key functional insect groups, including bees, syrphid flies, butterflies, and predatory insects (Parmentier et al. 2024). These practices can transform biologically depleted farmland into vibrant, species-rich habitats.

Beyond their role as stand-alone habitats, these semi-natural features contribute to ecological connectivity—a critical factor in the conservation of biodiversity. Flower strips and hedgerows serve as corridors linking fragmented habitats, facilitating species movement and genetic exchange. Such connectivity reduces the risk of local extinctions and supports ecosystem resilience. Research by Buhk et al. (2018) indicates that allocating just 8–10% of farmland to habitat-enhancing elements is sufficient to measurably increase populations of both generalist and specialist pollinators, yielding tangible gains in ecosystem service delivery, particularly for pollination and pest regulation (Kremen & M’Gonigle 2015; Kowalska et al. 2022).

Among the most valuable contributions of NbS is their support for pollinators and beneficial insects, which are essential to both wild and cultivated ecosystems. Meta-analyses reveal that flower strips and hedgerows can increase natural pest control services by an average of 16%, while also significantly enhancing pollinator diversity in neighbouring crops (Albrecht et al. 2020). Factors such as plant species richness, habitat structure, age, and location all influence the effectiveness of these practices. Notably, herbaceous layers within hedgerows and flower-rich margins have been shown to provide crucial resources for wild bees and hoverflies, including nesting, sheltering, and overwintering habitats (Albrecht et al. 2020).

## Hydrological and Climatic Processes (Regulation & Maintenance Services)

NbS in agriculture significantly enhance hydrological cycles and climate resilience at multiple scales—from individual fields to landscapes. Through subtle yet powerful ecological mechanisms, NbS help stabilize microclimates, retain water during dry periods, and sequester carbon. Collectively, these benefits strengthen both food production and ecosystem health.

Microclimate stabilization is often achieved through targeted vegetation elements such as windbreaks and shelterbelts. These linear tree and shrub plantings mitigate wind speed, reducing evapotranspiration and moderating temperature extremes downwind. Moreover, windbreaks positively regulate air temperature, humidity, and soil moisture—fostering more favourable crop microclimates while providing shade for livestock and reducing heating/cooling energy demands (Enescu et al 2025).

Water retention and drought mitigation are achieved through improved soil structure and vegetation cover. No-till practices, especially when combined with cover crops, enhance soil organic matter and water infiltration, conserving moisture and reducing evaporation. Similarly, agroforestry systems—such as alley cropping and windbreaks—boost groundwater recharge and stabilize soil health, strengthening farm resilience during dry spells. These mechanisms are essential in regions like the Western Balkans, where summer droughts are intensifying (Király et al 2023, Županić et al 2021).

Carbon sequestration is another key climate regulation service delivered by NbS. Agroforestry systems, including windbreaks, integrate trees and shrubs to store carbon both above and below ground. Estimates show windbreaks on just 3–5% of farmland can significantly enhance carbon storage and reduce greenhouse gas emissions (Király et al 2023).

NbS also play a vital role in water regulation and purification. Vegetated filter strips, riparian buffers, and cover crops intercept sediment, nutrients, and agrochemicals before they enter waterways. This not only protects downstream ecosystems and human health but also contributes to cleaner drinking water supplies and reduces eutrophication in lakes and rivers.

## Soil Formation, Nutrient Cycling, and Erosion Control (Regulation & Maintenance Services)

Healthy soils are the bedrock of sustainable agriculture, and nature-based solutions play a vital role in preserving and restoring soil integrity. Key NbS practices—such as vegetated filter strips, buffer zones, and cover cropping—not only reduce erosion but also regenerate organic matter and reinforce root structures, yielding long-term gains in soil fertility and resilience.

One of the most significant functions of NbS is reducing runoff and sedimentation. Vegetative filter strips—buffer zones of grass, shrubs, or mixed species placed along field edges or watercourses—can trap sediment and reduce nutrient runoff, dramatically limiting downstream water pollution. These strips slow surface flow, promote infiltration, and prevent soil detachment by rain, forming a low-cost yet effective barrier against erosion (Enescu et al 2025).

## Agricultural and Societal Benefits (Provisioning, Regulating, and Cultural Services)

NbS bring tangible societal and agricultural gains by harnessing ecosystem services to improve productivity, landscape quality, and community well-being. Through interventions like flower strips, hedgerows, and habitat corridors, farmers benefit not only through enhanced crop performance but also through strengthening the social and cultural fabric of rural landscapes (Wenzel et al 2024).

Beyond their ecological and production benefits, NbS in agriculture significantly enrich the aesthetic appeal of farmland and create new opportunities in agri-tourism. Flower-rich field margins, mixed vegetation, and semi-natural elements add visual beauty to otherwise monotonous landscapes, transforming them into culturally meaningful and inviting places. Studies from rural Spain and China demonstrates that picturesque flowering crops—highlighted by rapeseed fields and diverse vegetable patterns—enhance visitors' landscape appreciation and encourage site-specific tourism (such as wildflower trails or seasonal blooms), directly supporting local economic development (Ferreira et al 2022, Wang et al 2023). Such findings underscore that landscape aesthetics and biodiversity are deeply interconnected: visually appealing agricultural landscapes often reflect ecological richness and cultural heritage, offering immersive, nature-based experiences for tourists.

Integrating NbS not only restores biodiversity and ecosystem services but also elevates the scenic and cultural value of agroecosystems, reinforcing rural identity and community pride. For many farmers, these landscape enhancements serve as landmarks that draw visitors, enabling agri-tourism ventures, on-farm events, and experiential educational activities. By combining ecological function with visual and cultural appeal, NbS become a catalyst for complementary income streams, bridging ecological sustainability and socioeconomic resilience.

## 6 MEASURING POTENTIAL AND PERFORMANCE OF NBS IN AGRICULTURE

### 6.1 Data-based assessment of societal challenges and NbS

The implementation of NbS requires an evidence-based approach during every phase of the project (Figure 1). Using quantifiable indicators for the assessment and evaluation of

- the most pressing societal challenges,
- the initial condition of the site,
- the effectiveness of the implemented measures,
- long-term monitoring
- as well as the general project progress and successful implementation (output and result indicators – see 9.3)

is crucial for the realisation of riparian buffer zones or NbS in general. The development of a concept in meaningful indicators enables the implementer before, during and after the project to effectively track changes, impact and success over time. Through adaptive management the multifunctional benefits are effectively and sustainably maintained while at the same time the community resilience can be monitored. The use of clear and informative indicators also facilitates the project communication and engagement of the stakeholders.

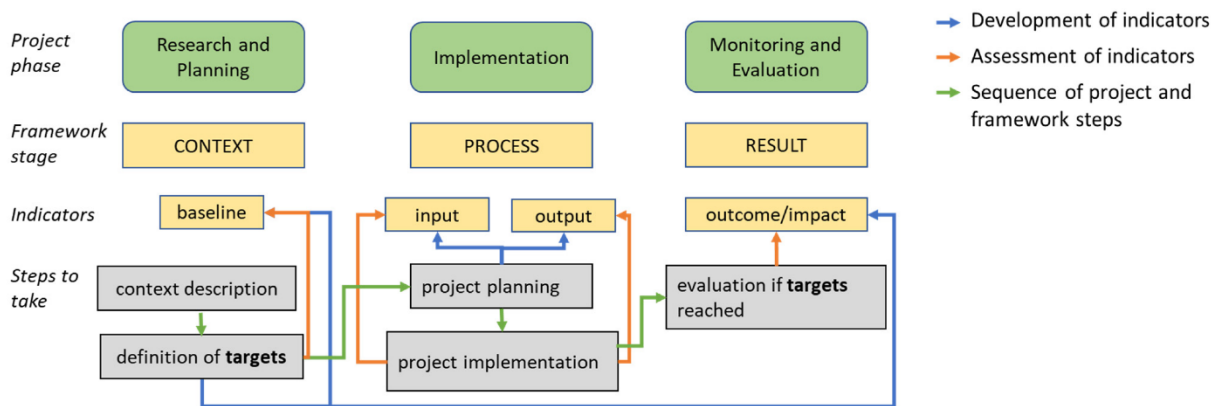


Figure 1 - The relations of indicators, project phases and framework stages. (Figure by Hale et al., 2023; © CC BY 4.0)

To measure the implications of the actions taken and the benefits that are starting to materialise, several indicators can be used. Their selection can be adapted according to the available resources, expertise and the pursued goals, whereby a combination of several indicators is favourable.

## 6.2 Indicators for assessment and evaluation of societal challenges and NbS

Using quantifiable indicators for nature-based solutions in agriculture, enables implementers and stakeholders to effectively assess and evaluate changes over time, during the project and in the post-project phase. Through adaptive management, the multifunctional benefits can be maintained effectively and sustainably. At the same time, community resilience can be monitored.

To measure the implications of actions taken and benefits starting to materialise, several indicators can be used. These can be selected according to available resources, expertise, and the goals pursued, with a combination of several indicators being favourable.

### Ecological Indicators

For wildflower pollinator strips, core ecological indicators are (i) pollinator abundance and richness quantified via standardized transect counts or pan traps, and (ii) floral resource availability (flower density/phenology) to interpret service supply through time; both link directly to measured gains in beneficial insects (Albrecht et al., 2020; Westphal et al., 2008).

For hedgerows/windbreaks, ecological condition is tracked with bird and invertebrate richness/abundance, structural diversity (tree–shrub species, height/width, presence of herb layer), and continuity/length as proxies for habitat quality and corridor function (Holland et al., 2016; Staley et al., 2012).

For vegetated filter strips, key ecological indicators include vegetation cover and species composition (stability, perenniality) and downstream water-quality metrics (nitrate, phosphate, suspended sediment, and pesticide concentrations), which capture their filtering performance (Zhang et al., 2010; Mayer et al., 2007).

Across all three NbS, landscape connectivity metrics (e.g., corridor length/width; graph-based indices) help evaluate how elements reduce fragmentation and facilitate movement of target taxa (Kindlmann & Burel, 2008). Where climate regulation is an objective, carbon indicators (above-ground biomass for woody features; soil organic carbon for strips and filters) are monitored repeatedly to detect sequestration trends (Kay et al., 2019).

## 7 Agronomic Indicators

To link NbS to production outcomes, pollination success (fruit/seed set, pollen limitation indices) and yield stability in pollinator-dependent crops are monitored adjacent to wildflower strips and hedgerows, providing a direct service read-out (Garibaldi et al., 2013; Blaauw & Isaacs, 2014). Biological pest control is assessed using pest densities, parasitism/predation rates (sentinel prey/eggs), and beneficial–pest ratios along field edges adjoining strips or hedgerows (Letourneau et al., 2011; Tschumi et al., 2016). For vegetated filter strips, agronomic performance is captured by runoff volume, infiltration capacity, sediment retention, and nutrient retention efficiency (kg N/P retained ha<sup>-1</sup> yr<sup>-1</sup>), all measured with paired-plot or edge-of-field monitoring (Zhang et al., 2010; Dosskey et al., 2010). A cross-cutting set of soil indicators—soil organic matter, microbial biomass/activity, and aggregate stability/infiltration—provides a common agronomic “health” signal for all three NbS over multi-year horizons (Bünemann et al., 2018). Where microclimate buffering is relevant for

hedgerows/windbreaks, near-crop wind speed, air/soil temperature, and soil moisture sensors document service delivery to adjacent crops (Holland et al., 2016).

For all three NbS, decision-relevant socio-economic monitoring includes adoption and maintenance rates (area or share of fields/edges under NbS), implementation and management costs, and partial budgets/cost–benefit ratios that net out input savings (e.g., reduced insecticide use) against establishment/management expenses (Pywell et al., 2015; Batáry et al., 2015). Farmer perceptions and willingness-to-adopt are tracked via validated survey instruments, as they predict persistence and scaling of practices (Prokopy et al., 2008). For wildflower strips and hedgerows, co-benefit indicators such as on-farm labour requirements, time to service delivery, and landscape aesthetics/recreation scores (social valuation surveys) help capture cultural services alongside economics (Blaauw & Isaacs, 2014; Holland et al., 2016). For vegetated filter strips, avoided downstream costs can be inferred via improvements in edge-of-field water-quality metrics linked to established dose–response valuations in the literature (Zhang et al., 2010). Finally, to reflect system transformation rather than one-off projects, portfolio indicators—tracking the diversity and spatial coverage of NbS at the farm/landscape scale—align monitoring with multifunctionality goals (Tamburini et al., 2020).

## 7.1 Data availability

A sound database is the key to evaluating the current situation and identifying negative or positive developments. In the long run, it facilitates the monitoring of the measures implemented in the area and, ideally, demonstrates the positive impact of the agricultural NbS. If necessary, appropriate actions can be implemented to improve the status on site, based on ongoing collection of data. Depending on the indicator, several already existing data sources can be used as well.

However, in the Western Balkans, data are often difficult to obtain or simply do not exist, which poses a significant challenge for comprehensive evaluation and monitoring. Therefore, for many cases, it remains necessary to assess data directly on site to ensure adequate monitoring and informed decision-making.

### Geospatial and Land Use Data

- **Data Type:** Geospatial data on land cover and land use patterns, which help analyse land cover change in agricultural landscapes and connectedness of habitats and corridor elements.
- **Source:** European Environment Agency (EEA) and CORINE Land Cover.
- **Accessibility:** Freely available for download from the EEA’s website.
- **Link:** [CORINE Land Cover+Backbone](#)
- **Usage:** Geospatial data on land cover and land use patterns support the identification of priority areas for interventions, inform the design of context-specific strategies such as agroforestry, cover crops, or vegetated buffers, and enable continuous monitoring of biodiversity and ecosystem service outcomes. By visualizing trade-offs, guiding adaptive management, and facilitating evidence-based policy and participatory decision-making, geospatial analysis ensures that NbS interventions are both ecologically effective and socio-economically viable.

## Biodiversity and Ecological Data

- **Data Type:** Numeric and geospatial data on species distribution, habitat types, and ecosystem services.
- **Source:** Biodiversity databases such as the Global Biodiversity Information Facility (GBIF) and local inventories maintained by environmental agencies or NGOs.
- **Accessibility:** GBIF is publicly accessible, though local biodiversity databases may have restricted access or be limited to aggregated data.
- **Link:** [GBIF](#)
- **Usage:** Biodiversity and Ecological Data provide insights into species presence, habitat quality, ecosystem interactions, and key ecological processes. This information helps identify areas where interventions—such as habitat restoration, pollinator-friendly plantings, or agroforestry—can maximize ecological benefits. By informing the design, monitoring, and adaptive management of NbS, biodiversity data ensure that agricultural practices support ecosystem health, enhance resilience, and maintain critical services such as pollination, pest regulation, and soil fertility.

## Soil, Water, and Climate Data

- **Data Type:** Numeric and geospatial data on temperature, precipitation, and other climate variables relevant for hydrological modelling and ecosystem resilience.
- **Source:** National Meteorological Institutes, the World Bank Climate Change Knowledge Portal, and the European Centre for Medium-Range Weather Forecasts (ECMWF).
- **Accessibility:** Publicly accessible through national services or global datasets like ECMWF.
- **Link:** [ECMWF Climate Data](#)
- **Usage:** Soil, Water, and Climate Data provide critical information on local environmental conditions. Soil data informs decisions on crop selection, cover cropping and soil amendment practices, while water data guides irrigation planning, wetland restoration and water retention measures. Climate data, including information on temperature, rainfall and extreme weather patterns, helps to tailor nature-based solutions strategies, enhancing resilience against climate variability and optimising the delivery of ecosystem services.

## European Soil Data Resources: Properties, Functions, and Threats (ESDAC)

- **Data Type:** Data sets on soil properties on a national, European or global scale, covering different categories, such as derivatives of the European Soil Database (ESDB), soil threats, functions, as well as point data (from e.g. LUCAS) and other projects.
- **Source:** European Soil Data Centre (ESDAC)
- **Accessibility:** The ESDAC provides datasets that can be downloaded freely or require a prior registration.
- **Link:** [ESDAC](#)
- **Usage:** The European Soil Data Centre (ESDAC) offers comprehensive datasets on soil properties, functions, and threats at national, European, and global scales, including derivatives of the European Soil Database (ESDB), soil monitoring projects like LUCAS, and thematic data on erosion, carbon, and nutrient cycling. These datasets are crucial for

designing and implementing NbS in agriculture by identifying vulnerable areas, guiding practices such as buffer strips, cover crops, or agroforestry, and monitoring soil health over time. By providing accessible and science-based information, ESDAC supports evidence-based decisions that enhance soil functions, improve resilience, and align agricultural management with ecological processes.

## Satellite Imagery and Remote Sensing Data

- **Data Type:** High-resolution satellite imagery consisting of several bands providing various information about land cover, moisture, water coverage, plant cover, etc.; suitable for mapping vegetation, land use changes, and analysing riparian buffer zone effectiveness.
- **Source:** Copernicus Sentinel Program and Landsat by the United States Geological Survey (USGS).
- **Accessibility:** Freely available through the Copernicus Open Access Hub and the USGS Earth Explorer.
- **Link:** [Copernicus Open Access Hub](#)
- **Usage:** Satellite imagery and remote sensing data provide up-to-date, high-resolution information on land cover, crop health, soil moisture and vegetation dynamics, enabling precise mapping and monitoring of agricultural landscapes. These technologies can be used to identify suitable areas for interventions such as cover crops, agroforestry or buffer zones. They can also be used to track changes in biodiversity and ecosystem services over time and to help assess the effectiveness of NbS practices.

## Agricultural and Socioeconomic Data

- **Data Type:** Farm-level statistics on crop production, livestock numbers, land management practices, farm size, ownership structures, input use (e.g., fertilizers, pesticides), as well as socioeconomic indicators such as income levels, labor availability, and market access.
- **Source:** National statistical offices, agricultural censuses, farm surveys, and international databases such as FAOSTAT and Eurostat.
- **Accessibility:** Varies by economy; some datasets are freely available through open government portals or FAO, while others may require institutional access.
- **Link:** FAOSTAT Database
- **Usage:** Agricultural and socioeconomic data provide critical insights into farming practices, resource availability, and local livelihood conditions. Farm typology and management systems help distinguish between large-scale intensive farms, smallholders, or subsistence farmers, ensuring that NbS strategies are tailored to different production contexts. Socioeconomic drivers and incentives, such as access to markets, subsidies, or labor, reveal the conditions that either support or hinder the adoption of NbS. Together, these data help identify regions where small-scale farmers may need targeted support, assess trade-offs between production and conservation, and ensure that interventions are socially equitable and economically viable.

## Additional Resources

- **National Statistical Offices:** Most Western Balkan countries publish agriculture and rural statistics on the sites of the respective governmental offices:
  - **Serbia:** <http://www.stat.gov.rs>
  - **North Macedonia:** <http://www.stat.gov.mk>
  - **Albania:** <http://www.instat.gov.al>
  - **Bosnia and Herzegovina:** <http://www.bhas.gov.ba>
  - **Montenegro:** <https://monstat.org>
  - **Kosovo\*:** <https://ask.rks-gov.net>

## 8 RESOURCES

### 8.1 Financing Nature-based Agricultural solutions

Financing Nature-based Solutions (NbS) can be a complex endeavour. While some of nature's contributions generate commodities that can be traded and reap direct monetary benefits (e.g. agricultural or forestry products), others constitute public goods that do not create a direct financial return and cannot be sold on markets easily (e.g. climate regulation or recreational and educational value).

Direct monetary returns on investment are often small and occur at a later stage of project implementation. The wider, less tangible socio-economic benefits for local communities are often not factored into cost-benefit analyses. That is one reason why NbS remain underfunded and rely mostly on public money for financing. Upscaling NbS through unlocking additional (private) capital requires innovative financing schemes, such as blended finance or public-private partnerships and the accompanying governance architecture. Furthermore, the involvement and efficient management of various stakeholder groups (e.g. landowners, utility companies, municipal authorities, local communities, etc.) is required to ensure the durability of funding streams towards the ecological intervention, and, ideally also for the ongoing monitoring activities beyond the implementation stage.

Other important considerations include the specific characteristics of the ecosystem, and the ecosystem services it provides. As with all other project components, the financing solution should be tailored to the geographical and ecological context. In riverine systems, landowners and communities upstream and downstream of the NbS implementation site must be included in the planning process as well as potential financial agreements on profit-sharing or compensation. The situation is different for projects in forestry or agricultural systems where ownership structures are more clearly defined.

#### [INFOBOX FOR AGRI NbS START]

According to a study by the European Investment Bank, the majority of NbS in agricultural systems involve public fundings following regulatory drivers such as the EU Common Agricultural Policy. The CAP also acts as the primary funder in most of the cases, with an annual estimated minimum investment of up to €15 billion. In most cases, projects are financed by donations or grant funding but rarely are led by private investors. Despite lacking information investment and monitoring of Agri NbS, the severity of ecosystem degradation highlights the necessity of actions in the agricultural landscape. With the existence of a financial instrument with huge investments, the potential for NbS is significant. (EIB, 2023)

#### [INFOBOX FOR AGRI NbS END]

In the face of these challenges, it becomes clear that, in most cases, there will be no simple financial solution for funding NbS. Depending on the context, the best fit for the project at hand might be a funding mechanism or a mix of multiple funding mechanisms (grants, loans or equity; public or private funds). Multilateral development banks (e.g. EIB, EBRD or the World Bank), commercial banks, local municipalities, local landowners and businesses, regional and state authorities, NGOs, philanthropic donors and grass-roots organizations can all play an important role in the financing of NbS. It is essential to identify suitable financing and insurance solutions from the very start of the project's planning process.

## 8.2 Funding opportunities for NbS on EU-level (Multiannual financial framework 2021-2027)

The EU funding landscape offers various avenues to fund NbS including some open for non-EU countries, including the Western Balkan economies. Relevant EU funding options include:

- [Common Agricultural Policy \(CAP\)](#):** The total expenditure for the common agricultural policy (CAP) is €386.6 billion, while 40% of the resources are intended to be invested in climate actions. The national CAP Strategic Plans help Member States align with EU goals and the European Green Deal while addressing local needs. They promote sustainable agriculture, support rural economies, strengthen farm incomes, ensure food security, drive climate action, and protect natural resources and biodiversity. The total funding budget for the measures to implement this transition is being split in two sub-funds (or “pillars”). The first pillar is the European agricultural guarantee fund (EAGF), amounting to €291,1 billion, while ~€270 billion are dedicated for income support schemes (including schemes focused on climate, environmental protection, and animal welfare). The second sub-fund is the European agricultural fund for rural development (EAFRD), amounting to €95.5 billion allocations. Among the objectives of funded projects are safeguarding natural resources through sustainable practices and climate action. (EC, 2025)  
An overview of the CAP financing via a dashboard along with other information can also be found at the [AgriData Portal](#) of the European Commission.
- [EU pre-accession assistance for rural development \(IPARD III\)](#):**The IPARD goal is to support beneficiaries with the implementation of reforms to align with the EU values and standards. The core objectives of the programme are strengthening the agri-food sector, enable sustainable resource management and enhance the climate resilience. The EU has allocated €990 million for the IPARD III programmes. However, the total investment in IPARD-funded projects will exceed this amount, as each beneficiary country has to contribute through national public funding. Additionally, for many measures, recipients are required to co-finance a portion of their project costs. For further information on the total allocated amounts on the national level, [national IPARD programmes](#) are available.
- [Economic and Investment Plan \(EIP\) for the Western Balkans 2021-2027](#):** As part of the Western Balkan Investment Framework (WBIF), the EIP prioritising Environment & Climate, is funding projects with the focus on improving infrastructure, adopting climate-smart technologies, modernising water and waste management systems, and enhancing resilience to extreme weather conditions. The latter is also specifically targeting the protection of biodiversity. The WBIF grants for environmental projects equivalent 11% of the total WBIF budget.
- [Programme for the environment and climate action \(LIFE\)](#):** Subprogrammes 1. Nature and biodiversity and 3. Climate change mitigation and adaptation are best suited for the funding of NbS. The funding mechanism mainly consists of grants and co-financing rates range from 60-95 %. Non-EU countries associated with the LIFE programme, including candidate countries, can apply. Projects funded under the LIFE programme typically range between EUR 1 and 10 million, projects under EUR 500.000 are rarely funded.
- [Horizon Europe](#):** one of the four key strategic aims for the programme is “restoring Europe’s ecosystems and biodiversity, and sustainably managing natural resources to ensure food security and a clean and healthy environment.” The funding mechanism consists of grants. Non-EU associated countries, which includes all WB economies, can apply for funding. In the

period 2021-2023 the average grant size in the Horizon Europe programme was EUR 2.9 million.

- [InvestEU programme](#): an instrument to boost green growth in the EU and to dedicate resources to “the enhancement and restoration of ecosystems and their natural and biodiversity services by means of green and blue infrastructure projects, such as sustainable agriculture, forestry and fishery”. This funding mechanism consists of an EU budgetary guarantee that supports implementing partners in increasing their risk-bearing capacity. The Invest EU programme is also open for candidate and potential candidate countries.

In addition to environmental and technical requirements, EU funding schemes often emphasise the importance of integrating gender considerations throughout the project cycle. This includes promoting gender equality, ensuring balanced participation, and addressing gender-specific impacts of NbS interventions in project design, implementation, and reporting.

A comprehensive overview of the different EU funding opportunities, their components, requirements and eligibility criteria can be found in the European Commission brochure: “Find Your EU Funding Programme for the Environment”.

### 8.3 Other Funding Sources and Programmes

Funding for NbS can also potentially be accessed through the [Western Balkan Investment Framework](#), which is (co)funding projects in the environment sector.

Further information on NbS funding, including “The Nature-Based Solutions Opportunity Scan”, can be found on the website of the [Global Program on Nature-Based Solutions for Climate Resilience](#), an initiative of the Global Facility for Disaster Reduction and Recovery together with the World Bank.

A database of case studies and good practice examples for NbS, including information on financing, is available on the website of the [Nature-Based Solutions Initiative](#) of the University of Oxford.

Regarding different ways to leverage private capital for investment in freshwater systems, the [Guidebook](#) “Nature-based Models for Unlocking Private Investment into Water Quality and Availability” published by the Green Finance Institute includes case studies of proven, revenue-generating investment models for freshwater NbS.

An example for a transboundary conservation trust fund, based on the economy-level, is the [Prespa Ohrid Nature Trust \(PONT\)](#). Offering two grant programmes (the Protected Area Programme and Environmental Actor Programme) with a co-financing rate of 25%, PONT ensures long-term, sustainable financing. Its mission is to foster the protection and effective management of key conservation areas as well as the cooperation between NGOs and local people.

#### Sources and further reading

To deepen the understanding of the crucial topic of project financing, the following references and links provide a selection of key resources. They include both the sources cited in Chapter 6 and additional materials that offer further insights and guidance for readers interested in exploring the subject in more detail:

Calliari, E., Castellari, S., McKenna, D., Linnerooth-Bayer, J., Martin, J., Mysiak, J., Pastor, T., Ramieri, E., Scolobig, A., Sterk, M., Veerkamp, C., Wendling, L. & Zandersen, M. (2022). Building climate

resilience through nature-based solutions in Europe: A review of enabling knowledge, finance and governance frameworks. *Climate Risk Management* 37 (2022), 100450.  
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Chausson, A., Welden, E.A., Melanidis, M.S., Gray, E., Hiron, M., Seddon N. (2023). Going beyond market-based mechanisms to finance nature-based solutions and foster sustainable futures. *PLOS Clim*, 2(4), e0000169.  
<https://journals.plos.org/climate/article?id=10.1371/journal.pclm.0000169>

EIB (2023). Investing in nature-based solutions – State-of-play and way forward for public and private financial measures in Europe.  
[https://www.eib.org/attachments/lucalli/20230095\\_investing\\_in\\_nature\\_based\\_solutions\\_en.pdf](https://www.eib.org/attachments/lucalli/20230095_investing_in_nature_based_solutions_en.pdf)

Thompson, A., Bunds, K., Larson, L., Cutts, B. & Hipp, J.A. (2022). Paying for nature-based solutions: A review of funding and financing mechanisms for ecosystem services and their impacts on social equity. *Sustainable Development*, 2023, 31, 1991-2066.  
<https://onlinelibrary.wiley.com/doi/10.1002/sd.2510>

UNEP FI (2024). Recommendations for Scaling Finance for NbS.  
<https://www.unepfi.org/wordpress/wp-content/uploads/2024/08/Recommendations-for-designing-regulatory-frameworks-to-scale-finance.pdf>

Van Raalte, D. and Ranger, N. (2023). Financing Nature-Based Solutions for Adaptation at Scale: Learning from Specialised Investment Managers and Nature Funds. Global Center on Adaptation and Environmental Change Institute, University of Oxford.  
[https://www.eci.ox.ac.uk/sites/default/files/2023-12/Financing\\_NbS\\_for\\_Adaptation-GCAOxford2023-finalv2.pdf](https://www.eci.ox.ac.uk/sites/default/files/2023-12/Financing_NbS_for_Adaptation-GCAOxford2023-finalv2.pdf)

- Toolkits and manuals for implementation
- Case study databases and research publications

## 9 IMPLEMENTATION: FROM IDEA TO REALIZATION

This chapter provides a step-by-step guide to designing, implementing and maintaining riparian buffer zones in line with the concepts covered by the IUCN's eight criteria of the Global Standard for Nature-based Solutions (IUCN, 2020a).

The right approach helps to minimise potential errors and risks, and is key for a successful and sustainable realisation. It is advisable that the process follows a phased, cyclical framework. Systematic planning, execution, and monitoring of the NbS, can maximise ecological and socioeconomic benefits. The approach contains three phases (Design and assessment, Implementation, Maintenance and evaluation), described in more detail in the subsequent chapters.

## 9.1 Phase 1: Design & Assessment

The first phase of implementing nature-based solutions in agriculture is crucial for establishing a solid foundation for a successful and sustainable initiative. This phase emphasises thorough site assessments, active stakeholder engagement and integrating biodiversity-focused practices into wider agricultural and land use planning frameworks. Taking a clear, strategic approach will ensure that nature-based solutions effectively enhance biodiversity while addressing environmental and societal needs, thereby securing the support of farming communities and other key stakeholders.

### 1. Conduct comprehensive site assessments

Use scientific research and traditional ecological knowledge to guide the implementation of nature-based solutions in agricultural landscapes. The process begins with a thorough assessment of the farm and its surrounding environment to identify suitable areas and practices that can enhance biodiversity while supporting agricultural productivity. Beyond identifying priority areas, this step generates critical data for designing targeted interventions. Piloting small-scale measures prior to full-scale adoption can help refine practices, build farmer confidence, and reduce risks.

The assessments include:

- **GIS mapping:** Use Geographic Information System (GIS) tools to map farmland features and surrounding habitats. High-priority areas can be identified based on factors such as habitat connectivity, pollinator needs, erosion risks, and potential for carbon sequestration. GIS data helps visualize ecological corridors and assess how NbS can integrate with existing ecosystems.
- **Field surveys:** Conduct on-site assessments to analyse soil health, vegetation types, habitat diversity, and water management systems. These surveys provide the ground-truthing needed to complement GIS data and highlight farm-specific challenges, such as degraded soils, invasive species, or lack of habitat for beneficial organisms.
- **Identify priority areas:** Combine GIS analysis and field survey data to select high-priority agricultural plots or landscape elements for NbS implementation. These may include hedgerow restoration, agroforestry zones, flower strips, wetlands, or fallow fields that provide refuges for biodiversity while delivering ecosystem services such as pollination or pest control.
- **Regulatory framework:** In addition to ecological and site-specific factors, it is necessary to assess the wider policy and legal context—namely existing regulations, land ownership, and relevant biodiversity conservation strategies. This includes obligations under frameworks such as the EU Biodiversity Strategy, the Common Agricultural Policy (CAP), or national agri-environment schemes. Understanding this framework also helps identify funding opportunities and incentives to support farmers in adopting NbS.

### 2. Address societal challenges

The next and most important step is to clearly identify the societal challenges that the NbS will address:

- Will it improve soil health and fertility, thereby reducing the need for synthetic fertilizers and supporting long-term food security?
- Increase resilience to droughts, pests, and diseases, thereby safeguarding livelihoods and reducing economic risks for farmers?
- Enhance biodiversity, thereby benefiting society through increased ecosystem services such as pollination, natural pest control, and nutrient cycling?

Stakeholders need to define the primary objectives, as this will shape the design of the agricultural system. For example, a farm designed to improve resilience against drought might prioritize practices like agroforestry and cover crops, whereas a farm designed to enhance biodiversity might include field margins, hedgerows, and diversified crop rotations.

Independent from the primary target, well-designed NbS in agriculture will always play a vital role in enhancing biodiversity. They create mosaics of habitats across farmland, offering shelter, food, and movement corridors for a wide range of species. During the planning and implementation phase, the assessment of the existing landscape and its ecological potential will support the integration of measures that strengthen local ecosystems. Incorporating native plant species in field edges, diversifying crops, and maintaining semi-natural habitats will provide critical resources for pollinators, soil organisms, and natural enemies of pests. These elements not only enhance the ecological value of agricultural landscapes but also increase their long-term resilience and productivity.

### 3. Stakeholder involvement and education

Involving stakeholders at every stage — design, implementation and maintenance — is essential to successfully implementing NbS in agriculture and improving biodiversity outcomes. A wide range of stakeholders from different backgrounds and with different interests need to be engaged, as they can contribute complementary expertise and perspectives.

Scientists can provide the ecological and agronomic expertise needed to guide biodiversity-friendly practices. Agricultural extension services and technical experts translate scientific insights into practical, farm-level applications. NGOs and civil society organisations mobilise resources, facilitate community engagement, and advocate for sustainable farming systems. Most importantly, farmers and local land users are the custodians of these solutions. Their traditional knowledge, cultural values and direct dependency on the land make them indispensable partners in ensuring the success and resilience of biodiversity-focused NbS.

It is equally important to integrate the public more broadly. Raising awareness, fostering transparency and encouraging active participation from consumers and citizens builds trust and strengthens acceptance of, and demand for, biodiversity-friendly agricultural products. Public involvement can help to shape context-specific approaches, promote stewardship, and ensure that the benefits of these interventions, such as improved pollinator health, increased soil fertility, and enhanced climate resilience, are widely understood and supported.

Including governments, NGOs, research institutions and private sector actors is also essential for the long-term economic sustainability of these measures. Fostering cooperation among these groups enables the establishment of stable funding mechanisms and incentives. Examples include agri-environmental schemes, biodiversity-friendly certification, and payments for ecosystem services. Government agencies play a particularly important role in policy setting, subsidy allocation, and monitoring.

A sound, transparent and inclusive communication plan is essential for the successful and lasting implementation of any project. It should incorporate three key strategies for engaging stakeholders at various levels.

**Information campaigns:** Launch educational initiatives to inform stakeholders, including farmers, landowners, policymakers, and consumers, about the ecological and economic benefits of biodiversity-oriented agricultural practices. These initiatives should highlight the role of stakeholders in improving ecosystem services, enhancing pollination, reducing pest pressures and increasing climate resilience. Sharing project outcomes at relevant events (e.g. the International Day for Biological Diversity, agricultural fairs, or science-policy conferences) can significantly increase outreach. Results can be further amplified by influential figures from science, farming, and politics. These campaigns should be inclusive, ensuring that both women and men have equal access to knowledge, training opportunities and decision-making processes.

**Hold community meetings and workshops:** Organise participatory forums where stakeholders can discuss objectives, exchange knowledge, and address concerns. Transparent communication builds trust and encourages cooperation. Pay special attention to fostering gender-balanced participation and creating safe, accessible spaces where women, young people, and other underrepresented groups can share their perspectives and contributions to biodiversity-friendly farming.

**Collaborative goal setting:** Work with stakeholders to develop a shared vision for biodiversity-focused agriculture. This process should incorporate diverse perspectives and balance conservation priorities with local livelihoods and cultural values. Integrating gender considerations ensures that initiatives respond to the needs and roles of all community members, acknowledging that women and men often experience and contribute to agricultural systems in different ways.

#### 4. Integrate land use planning and policy development.

To ensure long-term success, nature-based solutions that enhance biodiversity in agriculture need to be incorporated into broader land use planning and policy frameworks. Key steps include:

- **Incorporate NbS into land-use plans:** Update local and regional land use plans to designate priority areas for habitat creation, ecological corridors and multifunctional landscapes. This will ensure that biodiversity-friendly agricultural practices are recognised as essential components of sustainable land management.
- **Develop biodiversity-focused regulations:** Establish clear guidelines for agricultural practices that safeguard ecosystem services. These regulations should cover areas such as the use of pesticides and fertilisers, crop rotation, soil health management and the preservation of semi-natural habitats, in order to protect pollinators, soil organisms and wider biodiversity.
- **Create incentive schemes:** Encourage farmers and land managers to adopt nature-based solutions by offering financial incentives such as agri-environment payments, biodiversity credits, or eco-certifications. These schemes reward stewardship efforts, reduce economic risks and distribute responsibility for biodiversity conservation across society.

#### 5. Balancing Benefits Across Sectors in Agricultural NbS

Nature-based solutions in agriculture are uniquely positioned to deliver environmental, economic, and social benefits simultaneously, making them powerful tools for sustainable farming transitions. Practices such as hedgerow restoration, wildflower strips, cover cropping, and agroforestry illustrate this multifunctionality.

From an environmental perspective, these measures strengthen habitat connectivity, enhance pollinator diversity, and contribute to regulating water and soil processes. For instance, hedgerows and flower strips provide essential resources for insects and birds while improving landscape connectivity, thereby reinforcing ecosystem resilience.

Economically, NbS can improve farmers' resilience and productivity. Cover crops enhance soil fertility and reduce erosion, while agroforestry and shelterbelts increase yields and buffer farms against climate extremes by stabilising microclimates and reducing input needs such as fertilisers and pesticides. By relying more on ecological processes, farmers reduce dependency on costly external inputs and strengthen long-term farm viability.

On the social dimension, NbS also support cultural values, rural identity, and community cohesion. Hedgerows and diverse field margins often serve as cultural landmarks, while flower strips and visually diverse landscapes contribute to agri-tourism opportunities. Agroforestry and community-based approaches foster the exchange of traditional and local knowledge, supporting farmer-to-farmer learning and reinforcing cultural ties to agricultural landscapes.

Balancing these three dimensions—environmental, economic, and social—at the planning stage is crucial. Doing so not only helps avoid trade-offs, such as short-term yield losses during the transition phase, but also ensures that NbS are broadly supported and have lasting impact across sectors (Keesstra et al., 2023).

## 6. Financial planning and sponsorship

A sound financial plan is equally important as a well-structured, integrative and participative NbS design that considers biodiversity, food security and community engagement. This ensures that biodiversity-focused NbS projects are realistic, impactful, resilient and sustainable in the long term. A robust financial plan has several advantages.

**Feasibility and strategic planning:** A clear and realistic financial roadmap shows how resources will be allocated to design, implementation, monitoring and adaptive management. This approach reveals funding gaps early on, reduces the risk of underperformance and supports decision-making by linking project costs to expected ecological and socio-economic returns.

**Transparent budgeting:** Financial transparency builds trust among farmers, local communities and partner organisations. It also facilitates access to public and private funding by demonstrating accountability and preparedness, which are increasingly essential conditions for securing EU-level funding, such as CAP eco-schemes, LIFE or Horizon Europe.

**Adaptive management:** A robust financial structure enables continuous tracking of both expenditure and biodiversity outcomes. This flexibility is crucial for responding to unexpected ecological changes (e.g. the impact of climate change on habitats) and for adjusting the allocation of resources to maximise effectiveness.

As securing funding and sponsorship for agricultural NbS can be challenging, Chapter 0, 'Sources and further reading', provides a more detailed exploration of this topic, outlining a variety of financing mechanisms and opportunities.

## 9.2 Phase 2: Implementation

This phase brings NbS designs to life, with each ecological intervention planned to enhance biodiversity, productivity, and resilience:

### Wildflower Pollinator Strips

Implementing wildflower pollinator strips is an effective and practical nature-based solution for enhancing biodiversity, supporting agricultural productivity and sustaining ecosystem health. To ensure success, careful planning, local adaptation and ongoing management are essential.

Firstly, selecting and preparing the site is pivotal. Identify field margins or interior buffer zones where the strips will have the greatest impact. Choose locations near flowering crops or water sources to enhance ecological connectivity. Remove competing vegetation and lightly till the soil to create a firm seedbed. Regional adaptation is essential, so use seed mixes comprising native, local genotypes that bloom at different times of year to ensure a continuous supply of nectar and pollen. *Leucanthemum vulgare*, *Centaurea jacea*, *Trifolium pratense* and *Phacelia tanacetifolia* are commonly used species across Europe, but local variants should be selected to avoid maladaptation and preserve genetic diversity (Kowalska et al., 2022).

A well-designed wildflower strip includes a mix of annuals, biennials, and perennials to create long flowering periods and attract diverse insect taxa (Haaland et al., 2011). Optimal strip spacing—ideally less than 60 m from focal crops—ensures effective pollinator support across landscapes (Kowalska et al., 2022).

Follow regional agronomic practices when sowing. Broadcast seeds at an appropriate density (approximately 1–2 kg/ha) in early spring or autumn to allow the plants to establish before the peak of pollinator activity. Secure seed source traceability — ideally from regionally collected populations — to maintain ecological coherence and support long-term ecosystem stability.

Once established, management and maintenance are key. Annual mowing or mulching after peak flowering favours perennial species and prevents the dominance of aggressive weeds, such as grasses or thistles. Studies show that, even with annual mulching, perennial wildflower strips can significantly increase the abundance and species richness of wild bees and butterflies over multiple years, indicating that they are a sustainable component of farmland biodiversity (Krahner et al., 2024).

Finally, adaptive management is critical. Conduct annual monitoring of flower cover, bloom duration, and pollinator visits. Adjust seed mixtures, mow timing, or buffer size based on these observations. This flexibility allows strips to respond to changing ecological conditions and maintain high conservation value.

### Hedgerows and Windbreaks

Implementing hedgerows and windbreaks in agricultural landscapes is a multi-layered, biodiversity-rich approach that serves both ecological and farm productivity goals. A well-designed structure combines an understory of herbs, a mid-layer of native shrubs, and a canopy of trees, offering wind protection, soil stabilization, and vital wildlife corridors. The design should start with selecting native and climate-adapted species—for example, hawthorn (*Crataegus monogyna*), blackthorn (*Prunus*

spinosa), willow (*Salix* spp.), hazel (*Corylus avellana*), and alder (*Alnus glutinosa*)—to ensure resilience, ecosystem compatibility, and regional genetic integrity (Montgomery & Reid 2024).

Layered structure and spacing are essential for maximizing habitat complexity and utility. Trees are planted at intervals of 3–5 m, mid-layer shrubs at closer spacing, and an herbaceous layer sown beneath or beside to fill lower niches—creating vertical strata that support nesting birds, shelter small mammals, and foster diverse insect communities. This structural diversity also bolsters microclimate regulation and soil moisture retention (Albrecht et al., 2020).

Pruning and management are key to maintaining both ecosystem function and structural diversity. Gentle formative pruning in the first 2–3 years encourages multi-stem architecture; thereafter, cycle pruning every 2–3 years enhances fruit and flower production, offering extended forage for pollinators and frugivores. Overzealous annual flail cutting should be avoided, as it diminishes flowering and berries—critical resources for wildlife. Meta-analyses indicate that multi-tiered, structurally diverse hedgerows significantly outperform cereal monocultures in biodiversity metrics, acting as biodiversity hotspots and ecosystem service providers. (Kratschmer et al 2024)

Monitoring and adaptive care are imperative. Early assessments track survival rates, plant vigor, pest pressures, and presence of target wildlife such as bees, birds, or small mammals. Over time, hedge condition—including flower and fruit production—is noted to align pruning cycles with wildlife needs. These observations guide adjustments like reseeding the herbaceous layer, adjusting canopy density, or replacing underperforming species.

### **Vegetated Filter Strips**

Implementing vegetated filter strips (VFS) requires strategic design choices, appropriate species selection, and effective maintenance to maximize their capacity for sediment trapping and nutrient filtration.

Begin by selecting locations adjacent to drainage pathways, field edges, or waterways where surface runoff occurs in sheet flow conditions. Strips should ideally lie across the gradient to slow water velocity and allow sediment to settle. On rolling terrain, incorporate berms or check dams to prevent flow concentration. Past research indicates that VFSs can capture significant amounts of sediment, phosphorus and pesticide pollutants when properly designed (Arpino et al., 2023; Ramler et al., 2022).

Vegetation choice is equally critical. Use a blend of deep-rooting native grasses engineered for high water uptake—such as *Festuca arundinacea* or prairie species—as well as native wildflowers to enhance biodiversity and pollinator support. This mix intercepts pollutants and improves structural diversity. For phosphorus retention, Ramler et al. (2022) stress that soil layering and subsurface interactions are critical, proposing a three-dimensional design perspective.

Design parameters greatly influence performance. Studies recommend minimum widths of 3–6 m for typical agricultural sites, with wider strips for steeper slopes or larger catchment areas. Sheet flow should remain shallow and uniform; if water tends to channelize, consider grassed swales or level spreaders to dissipate energy. Proper buffer placement and even flow distribution are essential to maintain high contaminant reduction efficacy. Installation steps: prepare the soil via light tillage, ensuring adequate granularity and moisture; broadcast or hydro-seed the vegetation mix at densities corresponding to soil and runoff risk profiles; apply light mulch to protect germinating seedlings; and use markers or fences to prevent animal disturbances. (Schmitt et al 1999, Department of Environmental Quality 2011))

Maintenance centers around annual mowing or selective biomass removal after the growing season, which prevents woody encroachment and sustains herbaceous cover. Channel inspections are necessary to correct rills and reseed bare spots. According to dynamic modeling studies, maintenance intervals strongly influence contaminant removal rates and overall buffer longevity (Ramler et al., 2022).

### Further nature-based solutions in agriculture

In addition to standard practices, a variety of nature-based solutions can be incorporated into agricultural landscapes to enhance biodiversity and ecosystem services. These approaches support ecological connectivity and resilience and provide tangible benefits for farming systems and rural communities.

One effective measure is the creation of ecological corridors, such as continuous hedgerows or linked patches of habitat. Even relatively small areas of land — around 5 to 10 per cent of a farm's total area — can significantly enhance genetic exchange among pollinators and other wildlife populations (Buhk et al., 2018; Kremen & M'Gonigle, 2015). By reconnecting fragmented habitats, corridors contribute to the long-term viability of species while improving the ecological stability of surrounding fields.

Agroforestry systems are another multifunctional NbS. Practices such as alley cropping or integrating trees into silvopasture systems diversify habitats, enrich soils with organic matter and store carbon. Moreover, they buffer microclimates by reducing wind and temperature extremes, which is particularly valuable in the context of climate variability. Agroforestry also increases farm resilience by providing additional products, such as fruit, timber or fodder, during the off-season (Jose, 2009; FAO, 2021).

Seasonal interventions can be just as effective. For example, the use of flowering cover crops turns fallow periods into opportunities for supporting biodiversity. Sowing species such as clover or phacelia suppresses weeds, fixes nitrogen and provides abundant forage for insects, thereby linking the improvement of soil fertility with the conservation of pollinators (Wezel et al., 2014).

Above practices are complemented by small-scale yet highly impactful infrastructures, such as insect hotels. Made from simple materials such as wood and bamboo, they provide nesting sites for solitary pollinators. When placed near flower strips, they provide an inexpensive, low-maintenance way of increasing biodiversity. As well as their ecological function, insect hotels can also be used as powerful educational tools, engaging schools and communities in hands-on biodiversity stewardship.

Water management solutions can also contribute significantly. Creating wetland ponds with shallow, sloping banks and emergent vegetation, such as reeds, fosters rich habitats for amphibians, aquatic insects and birds. At the same time, ponds improve drought resilience by storing water and mitigating extremes in hydrological cycles (Hill et al., 2018). Thus, they link ecological restoration with farm-level climate adaptation.

Finally, rotational grazing in grasslands helps to maintain species-rich meadows. By dividing pastures into paddocks and moving livestock between them seasonally, farmers can prevent overgrazing, allow vegetation to recover and support species that nest on the ground. This method sustains botanical diversity while reducing the encroachment of scrub, making it an ecologically and agronomically sound practice.

## 9.3 Phase 3: Maintenance & Evaluation

The long-term success of nature-based solutions in agriculture hinges on more than just their initial design and implementation; sustained stewardship and systematic evaluation are also essential. Maintenance and monitoring are essential to ensure that the solutions continue to deliver ecological, social and economic benefits over time and can adapt to changing conditions.

### Systematic Monitoring & Care

Systematic monitoring and care form the foundation of effective stewardship. Regular field visits by trained teams enable practical interventions, such as replacing dead plants, repairing erosion-prone areas or controlling invasive species before they spread. These activities are complemented by biodiversity surveys, such as monitoring flowering cover, pollinator counts or bird observations, as well as soil and water quality testing. Together, these measures provide clear insights into the ecological performance of NbS, making their impacts visible in both scientific and practical terms.

### Adaptive, Community-led Management

Equally important is adaptive, community-led management. Farm-based events, workshops and citizen science initiatives create opportunities for local people to participate in monitoring and strengthen their sense of ownership of NbS measures. Data collected through monitoring is collectively reviewed, enabling stakeholders to agree on adaptive changes, such as modifying planting mixes, adjusting buffer widths or refining grazing practices. This flexible, participatory approach ensures that NbS remain relevant and resilient in the face of changing environmental and socio-economic conditions.

### Long-term Funding Foundations

Ensuring sustainability also requires a foundation of long-term funding. NbS are most effective when they are supported by a variety of stable funding sources, such as EU-level funds, NGO grants and local development budgets. Clear governance structures are vital to clarify maintenance responsibilities, establish oversight mechanisms and prevent stewardship gaps. Hybrid financing secures continuity and builds confidence among stakeholders and funders alike.

### Documenting Successes

Finally, documenting successes is a crucial element of evaluation. Both quantitative indicators, such as increases in pollinator abundance or improved soil quality, and qualitative outcomes, such as enhanced community cohesion or farmer testimonials, should be compiled in accessible and engaging formats. Sharing these results through workshops, reports and social media increases visibility, promotes learning across regions and encourages wider adoption of NbS in agriculture.

## 9.4 Transparency & Accountability

According to the Kunming-Montreal Global Biodiversity Framework, projects such as the implementation of nature-based solutions in agriculture must have sound monitoring of their progress and goals. This involves regular evaluations and reporting conducted transparently and responsibly. Defining feasible indicators helps assess the project's effectiveness in terms of biodiversity gains. It also facilitates the identification of challenges and lessons learned, as well as the adaptations and adjustments needed to get the project back on track. Transparent monitoring ensures that the implementing organisation, farming community or economy honours its commitments and can be held accountable if it does not. (CBD, 2022).

If these principles are followed, biodiversity-focused agricultural practices are less likely to be met with scepticism from the public or stakeholders. Without the necessary knowledge or scientific background, measures such as reducing pesticide use, setting aside land for habitat restoration or introducing crop diversification could be perceived as threatening to food production and local livelihoods. Setting up a transparent evaluation plan with clear indicators ensures better communication of methods, goals, and eventually, biodiversity outcomes (Cook et al., 2024).

When implementing any NbS or agricultural projects, trade-offs are inevitable, particularly when balancing biodiversity goals with food security and economic needs. For instance, converting some arable land into hedgerows or flower strips could greatly benefit pollinators and soil health, but would initially reduce the area available for cultivation. Open discussions, clear communication and participatory decision-making can help to identify and manage such trade-offs, ensuring that all voices are heard and conflicts are minimised.

# 10 ADVANCING NBS FOR AGRICULTURE IN THE WESTERN BALKANS

The EU4GREEN project organized the conference “Measures on the Field: Nature-based Solutions and Sustainable Water Use in Agriculture in the Western Balkans” in Podgorica, Montenegro, on 23–24 September 2025. The event gathered around fifty participants from civil society, academia, government institutions, and the private sector across the Western Balkans. During an interactive session entitled “From Challenges to Solutions,” participants examined the principal challenges, opportunities, and practical pathways for the application of Nature-based Solutions in agriculture. Discussions were structured around four thematic clusters: Community and Climate Resilience, Policy and Governance, Finance and Investment, and Knowledge and Awareness.

The following synthesis integrates the main findings of the conference with broader regional insights on the socio-economic and institutional barriers to implementing NbS in agricultural systems. Together, these reflections present a shared vision for how the Western Balkans can mainstream Nature-based Solutions as a cornerstone of sustainable and climate-resilient rural development.

### Community and Climate Resilience

The discussions on community and climate resilience highlighted the intensifying effects of climate change across the Western Balkans. Increasingly frequent droughts, floods, and late spring frosts, combined with wildfires, deforestation, and water scarcity, threaten agricultural productivity and rural livelihoods. These environmental pressures are compounded by socio-economic factors such as fragmented land ownership and the marginalization of small-scale, low-input farming systems that often practice traditional, biodiversity-friendly methods but remain outside formal support structures. Without secure tenure, access to subsidies, or technical advisory services, these farmers are less able to adopt NbS approaches such as agroforestry, vegetated buffers, or water retention measures.

Yet, these same small-scale systems represent an untapped foundation for resilience. Participants emphasized that Nature-based Solutions can enhance the capacity of rural communities to adapt to climatic extremes by working with, rather than against, natural processes. Measures such as rainwater harvesting, the creation of natural and artificial water reservoirs, and forest-based water retention were seen as essential to maintaining water security in both agricultural and ecological systems. Promoting autochthonous crop varieties resistant to climate variability, preserving soil moisture, and strengthening regional cooperation on shared water resources emerged as practical solutions.

Achieving these goals, however, requires an integrated, multi-sectoral approach that connects agriculture, ecology, and energy production. Such cooperation can ensure that ecosystem services are maintained across landscapes rather than fragmented by competing land uses. Participants also stressed that community engagement is critical: local governments, research institutions, and civil society organizations must co-design and co-implement NbS projects tailored to specific terrains and social contexts. The overarching lesson was that long-term resilience depends not only on ecological restoration but also on inclusive governance that empowers communities to become active stewards of their environments.

## Policy and Governance

The Policy and Governance cluster underscored the importance of coherent institutional frameworks for embedding NbS in agricultural and environmental planning. Across the region, policy fragmentation, overlapping ministerial responsibilities, and the absence of shared strategic documents have hindered the integration of NbS into national agendas. Participants observed that while many Western Balkan countries are aligning their policies with the European Green Deal and the Common Agricultural Policy (CAP), these frameworks often remain narrowly focused on productivity, thereby overlooking multifunctional landscapes that provide ecological benefits. For instance, mixed pastures, forest-edge grazing areas, or scrublands—valuable for pollination, water retention, and carbon sequestration—are frequently ineligible for subsidies because they fall outside conventional definitions of “productive” land.

This misalignment highlights a deeper institutional barrier: policy instruments are still poorly adapted to the multifunctionality inherent to NbS. To address this, participants proposed the creation of a regional task force on climate change and NbS to harmonize approaches across ministries and countries. They also called for river basin-based management planning that integrates agricultural and environmental objectives. Systematic policy analyses could help clarify overlapping mandates and identify opportunities to incorporate NbS into national strategies for agriculture, forestry, water, and land management.

The success of these efforts depends on the participation of diverse actors, including ministries, research institutions, and civil society organizations. Civil society can play a bridging role by translating best practices into policy recommendations, raising awareness, and supporting implementation at the

local level. Ultimately, effective NbS governance requires transparent coordination, cross-sectoral collaboration, and the use of evidence-based decision-making rooted in scientific knowledge and local experience.

### Finance and Investment

Financial and institutional constraints remain among the most persistent barriers to the large-scale adoption of NbS in the Western Balkans. The conference discussions revealed a system dominated by short-term donor projects, limited coordination between financial institutions, and fragmented access to international funds. This situation mirrors broader regional trends, where high initial investment costs, uncertain economic returns, and limited access to technical expertise deter both farmers and investors from engaging in biodiversity-friendly practices.

Participants agreed that financing mechanisms must evolve beyond project cycles to support long-term transformation. Public funds dedicated to climate adaptation and rural development should be expanded and aligned with NbS priorities. The establishment of a dedicated Nature-based Solutions Fund for the Western Balkans was identified as a key step toward ensuring stable and coordinated financing. Such a fund could pool resources from donors, governments, and private actors, channeling them toward integrated projects that combine infrastructure, ecosystem restoration, and community development.

Transparency, information-sharing, and coordination were identified as core enablers of financial success. Building trust among stakeholders—donors, civil society organizations, businesses, and research institutions—can enhance efficiency and accountability. Civil society, in particular, can act as an advocate and watchdog, ensuring that funds are used effectively and that marginalized farming communities are not left behind.

The cluster concluded that long-term financial planning, combined with inter-institutional collaboration, is essential for scaling up NbS. By integrating ecological value into economic systems and ensuring predictable funding streams, the region can shift from isolated pilot projects to systemic, landscape-scale implementation.

### Knowledge and Awareness

The final cluster focused on the persistent knowledge and awareness gaps that limit the adoption of Nature-based Solutions in agriculture. Despite the growing scientific evidence of NbS benefits—such as enhanced pollination, improved soil health, and climate resilience—many farmers, land managers, and policymakers remain uncertain about how to translate these concepts into practice. One major reason is that the ecological benefits of NbS often unfold over longer timeframes and are less immediately visible than the returns from conventional inputs like fertilizers or irrigation. As a result, many farmers perceive NbS as uncertain or non-essential investments, especially in economically constrained contexts.

This challenge is amplified by weaknesses in the regional agricultural extension systems, which often focus on conventional production techniques while offering little guidance on biodiversity-based management. In many Western Balkan countries, advisory services have been weakened by institutional reforms and funding shortages, leaving farmers without the technical support needed to adopt practices such as cover cropping, hedgerows, or multifunctional field margins. Furthermore, the scarcity of demonstration farms and peer-to-peer learning opportunities hinders innovation. Studies

and regional experience alike show that farmers are far more likely to experiment with new ecological practices when they can observe them firsthand and exchange experiences with peers.

Participants therefore emphasized the need to strengthen knowledge transfer mechanisms at all levels. This includes the creation of regional learning platforms, accessible online education tools for farmers and young professionals, and technology transfer centers that bridge research and practice. Integrating NbS into school and university curricula can foster early understanding, while social media campaigns and community outreach can increase public visibility and engagement. Crucially, a bottom-up, participatory approach is needed to ensure that knowledge flows both ways—between experts and practitioners—and that NbS are adapted to local realities.

Addressing knowledge fragmentation also requires stronger cooperation between conservationists, agronomists, and development specialists, who often operate in isolation. By harmonizing messages and providing consistent, practical guidance, the region can foster a more coherent and informed approach to NbS. In this sense, education, communication, and trust-building are not merely complementary actions but prerequisites for meaningful and lasting change.

### Synthesis

Taken together, the insights from the EU4GREEN conference and the broader regional context reveal that the effective implementation of Nature-based Solutions in the Western Balkans hinges on four interconnected pillars: community resilience, coherent governance, sustainable financing, and knowledge empowerment. The region's agricultural landscapes face pressing ecological and institutional challenges, yet they also offer immense potential for regeneration and innovation.

By integrating NbS into national and regional strategies, aligning financial systems with ecological priorities, and investing in knowledge-sharing networks, the Western Balkans can lead by example in demonstrating how agriculture and nature can thrive together. Nature-based Solutions are not only environmental tools but social contracts—linking communities, institutions, and ecosystems in a shared commitment to resilience, equity, and sustainability.

## 11 CONCLUSION

Nature-based Solutions (NbS) offer a transformative pathway for reconciling agricultural productivity with ecological restoration and community well-being. By integrating natural processes into farm management, NbS strengthen biodiversity, improve soil and water quality, and increase resilience to climate extremes—turning agriculture into an ally rather than a driver of environmental degradation. In the Western Balkans, where small-scale, traditional farming coexists with mounting ecological stress, NbS represent a practical and scalable means to achieve both environmental and socio-economic gains.

The study demonstrates that successful NbS depend on scientific rigor, participatory governance, and sustainable financing. Applying the IUCN Global Standard ensures that solutions are measurable, inclusive, and context-appropriate. Equally, embedding NbS into regional policies, land-use planning, and funding schemes guarantees their longevity and replicability. The report calls for the creation of enabling environments through knowledge sharing, farmer incentives, gender-balanced stakeholder participation, and adaptive management frameworks.

Ultimately, Nature-based Solutions in agriculture are more than technical interventions—they embody a paradigm shift toward regenerative, resilient, and equitable food systems. When implemented effectively, they deliver multiple co-benefits: restoring ecosystem health, supporting rural economies, enhancing landscape aesthetics, and contributing to the global goals of climate adaptation and biodiversity conservation. The Western Balkans, through initiatives like EU4Green, can become a regional model for how nature-positive agriculture underpins sustainable development and ecological recovery in Europe and beyond.

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