



Agriculture Sectoral Strategy: Gaining resilience through Nature-based Solutions

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Disclaimer: the contents of this strategy are the responsibility of the authors. It does not necessarily represent the views of their organisations, nor those of the organisations asked for feedback and mentioned in the acknowledgements.





Key messages

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- 1. The agricultural sector faces challenges like soil degradation, water scarcity, and biodiversity loss, weakening its resilience to climate change. Social and economic pressures, including rising food demand and regulatory shifts, further exacerbate these issues.
- 2. While impacted by climate and biodiversity crises, agriculture can help mitigate them through Naturebased Solutions at farm and catchment levels, enhancing resilience, food security, and environmental sustainability.
- 3. This strategy emphasizes multi-scale and multiactor cooperation, highlighting the need for societal awareness and knowledge-sharing to drive sustainable agricultural transformation.
- 4. Equipping farmers with knowledge, tools, and support is key to integrating Nature-based Solutions and restoring freshwater ecosystems.
- 5. Raising awareness of Nature-based Solutions showcases their benefits, encouraging informed consumer choices and community engagement.
- 6. Policy reforms, particularly within the Common Agricultural Policy (CAP), can enhance incentives and funding for Nature-based Solutions.
- 7. Multi-stakeholder landscape partnerships are vital for coordinating Nature-based Solutions at catchment and landscape levels.
- 8. Research and innovation in sustainable agriculture are crucial to proving feasibility and accelerating Nature-based Solutions adoption.
- 9. Market support, including ecosystem service payments and green certifications, can incentivize farmers and align markets with sustainability goals.
- **10.** The strategy outlines a phased approach from 2025 to 2050 to drive transformative change in agriculture.





MERLIN Executive Summary

European freshwater ecosystems are under severe pressures, many of which are substantially driven by agricultural activities. This Strategy presents a comprehensive roadmap for transforming the European Agricultural Sector to eliminate or reduce these pressures through the mainstreaming of Nature-based Solutions (NbS). It emphasises the Sector's critical role in addressing biodiversity loss, climate crises, and soil and water degradation while promoting sustainable farming practices that secure food production and ecosystem health.

The Strategy envisions a pathway to a transformed Agriculture Sector that mainstreams NbS into its practices, fostering resilient, productive, sustainable, and interconnected farming systems. Through this vision, EU agriculture will deliver high-quality food, while operating within planetary boundaries, with a firm commitment to achieving both intermediate (by 2030) and longer-term (by 2050) targets for climate change mitigation, adaptation, and biodiversity recovery. Farmers and farming systems will be recognised and rewarded by citizens and markets for their dual roles as food producers and ecosystem stewards. The strategy suggests six action points, phased from 2025 to 2050:

1. Engaging and assisting farmers to adopt NbS: Farmers are central to the implementation of NbS. This action focuses on empowering them with knowledge, practical tools, and financial support to integrate NbS into their farming practices. By providing accessible information and showcasing successful examples, this action aims to bridge knowledge gaps and demonstrate the shortand long-term benefits of NbS for resilience and productivity.

Increasing public support: Building 2. societal awareness is essential for mainstreaming NbS. The strategy highlights the importance of educating the public about the state of freshwater ecosystems, the challenges faced by farmers, and the benefits of sustainable practices. Initiatives include citizen science programs, farmer-led projects, and certifications, fostering NbS informed consumer choices and community involvement in ecological restoration.

3. Improving policy and regulatory frameworks: Current agricultural policies, particularly the Common Agricultural Policy (CAP), need reforms to better support NbS. This action calls for stricter enforcement of conditionalities (e.g. protecting wetlands and buffer strips) to ensure level playing fields for all, increased funding for collaborative restoration projects, and alignment with other European and national policies. Enhanced coherence between CAP and other funding mechanisms is crucial to incentivise NbS adoption and ensure long-term impact.

Initiating landscape partnerships: 4. Effective NbS implementation requires collaboration between stakeholders across catchments and landscapes. This action emphasises the establishment of active, multistakeholder, partnerships—involving farmers, municipalities, NGOs, and private actors-to coordinate efforts, share resources, and maximise collective benefits. Such partnerships will drive systemic change, aligning agricultural practices with ecosystem restoration goals.

Accelerating relevant 5. innovation: Research and innovation are pivotal to overcoming technical and economic barriers to NbS adoption. This action promotes the development of sustainable farming technologies, alternative crop systems, and innovative biomass-based products. It also supports adaptive practices tailored to diverse agro-ecological regions, ensuring that NbS are effective and scalable.

6. Securing market support for NbS: Markets play a crucial role in incentivising NbS adoption. This action focuses on creating new value chains and financial mechanisms, such as payments for ecosystem services (PES), green certifications, and eco-labelling. These initiatives aim to reward farmers for their contributions to ecosystem services, ensuring that sustainable practices are economically viable and socially valued.

Key outcomes of these actions are:

- → enhanced soil health, water retention, and biodiversity, making farming systems more resilient to climate impacts;
- → active public support for sustainable agriculture;





- → reformed policies so that they provide clear incentives and robust support for farmers to transition to NbS-based systems;
- → collaborative frameworks that enable coordinated action, bridging gaps between agriculture, conservation, and local communities;
- → innovative solutions that drive the development of sustainable farming practices tailored to diverse contexts; and
- → new financial mechanisms and market incentives that make sustainable

practices economically rewarding for farmers.

This Strategy invites key stakeholders, including farmers, policymakers, researchers, industry and finance leaders, and the general public, to join forces in reshaping European agriculture.

This Strategy serves as a starting point for transformative change, building on the MERLIN project's vision to mainstream freshwater restoration through Nature-based Solutions across Europe.





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Abbreviations and acronyms

- → CAP Common Agricultural Policy
- → CLLD Community-led-local development
- \rightarrow CoP Community of Practice
- \rightarrow CSRD Corporate Sustainability Reporting Directive
- ightarrow CSDDD Corporate Sustainability Due Diligence Directive
- → DG Agri Directorate-General for Agriculture and Rural Development of the European Commission
- → DG EAC Directorate-General for Education, Youth, Sport and Culture of the European Commission
- ightarrow DG Env Directorate-General for Environment of the European Commission
- → DG Regio Directorate-General for Regional and Urban Policy of the European Commission
- ightarrow DG Research Directorate-General for Research and Innovation of the European Commission
- → EARDF- European Agricultural Rural Development Fund
- \rightarrow EEA European Environment Agency
- \rightarrow EIP European Innovation Partnership
- → ELARD European Leader Association for Rural Development
- → LEADER LAGs -Liaison Entre Actions pour le Development de'Economie Rurale Local action groups
- → LIFE L'Instrument Financier pour l'Environnement
- ightarrow IUCN International Union for Conservation of Nature and Natural Resources
- \rightarrow NbS Nature-based Solutions
- → PES Payment for Environmental Services
- \rightarrow RTs roundtables
- \rightarrow SBTN Science Based Targets Network
- \rightarrow SPRING Sustainable Program for Irrigation and Groundwater Use
- → UAA EU's Utilized Agricultural Area
- \rightarrow UNEA United Nations Environment Assembly
- → WFD Water Framework Directive





1 Introduction

1.1 Background of the Strategy

Humankind has experienced the greatest climate and biodiversity crises of the modern era, affecting societies around the world and across different economic sectors, including the agriculture sector (Sector). Climate change has altered precipitation patterns throughout Europe, causing both droughts and more intensive precipitation related floods with growing frequency (Christidis et al., 2022). Land-use and land-cover changes, for instance linked to agricultural intensification and urbanisation, land drainage and dam constructions, have led to a loss of a large area of active floodplains, wetlands and riparian habitats and have contributed to habitat fragmentation and soil degradation (Power, 2010). The loss and the fragmentation of habitats negatively affected the biodiversity hosted by these riparian and floodplain landscapes and their ecosystem services, including the ones related to water absorption and retention (Kumar et al., 2021; Sarkar and Maji, 2022).

The agriculture Sector - understood as the establishments primarily engaged in growing crops, raising animals, and harvesting food or fibre from a farm, ranch, or their natural habitats - represents a 1.3% of total EU's GDP, or &225.6 billion in 2023 (Eurostat, 2024), while using about 38 % of EU total land area (157 million hectares) in 2020 (Eurostat, 2024), with a further 63 million hectares, 15%, "unused or abandoned with signs of previous use" (Valujeva et al., 2022). This percentage varies significantly both among and within EU Member States; for instance, farming occupies 60% of EU floodplains (Entwistle et al., 2019). The number of farms and farmers in the EU has over time decreased, with a particularly notable decline in small-scale farms (Eurostat, 2024). This trend is largely attributed to fewer young Europeans pursuing careers in farming, due to factors such as the substantial financial investment required for infrastructure, equipment, and land, as well as the challenges of establishing a financially sustainable business (Sutherland, 2023).

The agriculture Sector is inextricably linked to biodiversity, soil and water, as highlighted above. It can play a key role in landscape and freshwater restoration (Dudley and Alexander, 2017; Flávio et al., 2017). Working with the Sector, in effective collaboration with farmers, offers a huge potential to improve practices and land use patterns to positively impact the status of natural freshwater ecosystems as a means to increase societal resilience -and that of the Sector- to climate change and mitigate the crisis.

The European Green Deal has specifically identified a role for the Sector (Guyomard et al., 2023). Under its umbrella, the European Commission has adopted a package of proposals intended to set the EU on the path towards a green transition, with the ultimate goal of reaching climate neutrality by 2050. It calls for an integrated and cross-sectoral approach where different policies contribute to that shared climate-related goal, covering climate, environment, energy, transport, industry, sustainable finance and, of course, agriculture. The Green Deal included measures that implied a degree of challenge for farmers, such as fuel prices, new environmental regulations and bureaucratic systems. Those, added to other circumstances, as the impact of extreme weather events, the concentration of farming land in the hands of speculative investors, the increase in prices of agrochemicals, the low prices paid to the farmers, and the perception of unfair competition linked to free trade deals, are making it increasingly difficult to gain the farmers as allies for the full implementation of the Green Deal.

In this context and aware of the challenges, the <u>MERLIN project</u>¹ aims to mainstream freshwater ecosystem restoration using Nature-based Solutions (NbS) across all of Europe's freshwater environments, as a response to the biodiversity and climate crises. Within the MERLIN project NbS is understood as specific interventions working at the landscape or basin scale, to connect farmed land to the natural wetlands, floodplains and natural channels, which implies working at different spatial levels or scales, and may require cross-farm, collective action (see Box 1). The mainstreaming of NbS is defined as the deepening and broadening of their adoption and implementation. MERLIN works to



¹ Mainstreaming Ecological Restoration of freshwater-related ecosystems in a Landscape context: INnovation, upscaling and transformation



demonstrate best practices of freshwater restoration, implement innovative NbS at the landscape scale, upscale systemic restoration and investment opportunities, co-develop and mainstream restoration with local communities and private sectors and suggest practical solutions for transformative restoration (Box 2). MERLIN operates freshwater restoration projects across Europe and works with six economic sectors including the agriculture sector. Against this background, MERLIN aims at co-developing transformation strategies with the agriculture Sector and supporting further implementation of NbS (Boxes 1 and 2).

Box 1. Key terms used in this Strategy

Nature-based solutions (NbS), as agreed at the United Nations Environment Assembly (UNEA) in February 2022.

NbS are "actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services and resilience and biodiversity benefits."

In addition to this broadly agreed definition, the IUCN has developed a Global Standard to help funding agencies, policymakers and other stakeholders to assess and improve the effectiveness of NbS interventions. The framework consists of 8 criteria with 28 associated indicators with guiding questions, and counts on a Guidance Document and a Self-Assessment Tool (on demand) to help the user. All MERLIN cases (i.e., best-practice case-study demonstrators in terms of innovative restoration measures, types of governance and financing frameworks) have been evaluated against these standards.

Sustainable management of ecosystems is one of the key aspects of the UN definition of NbS. This aspect aligns with sustainable agriculture, emphasizing the responsible use and stewardship of natural resources to meet present needs without compromising the ability of future generations to meet theirs (Pusch et al., 2024).

In this strategy for the Agriculture sector, we refer to NbS as interventions on agricultural lands that not only benefit agricultural practises but also improve and/or modify managed or restored freshwater ecosystems to sustainably increase the provision of ecosystem goods and services. Interventions that contribute, individually or in combination, to reducing pressures on the (freshwater) environment include: 1) improving resource use efficiency to reduce emissions of nutrient and chemical pollutants and decrease water abstraction pressure, while maintaining agricultural productivity; 2) enhancing the management of soils, crops, and livestock, especially with a focus on improving soil functions, optimizing nutrient cycling at the field, farm, and regional levels, and increasing rainfall infiltration and soil water retention; and 3) adopting broader landscape approaches to restore natural catchment hydrology, promoting nutrient recycling, pollutant breakdown, and water storage (EAA, 2020a).

Mainstreaming, after Scott et al., 2018

Mainstreaming refers to the integration of objectives from one issue area into other domains where they are currently underrepresented (Karlsson-Vinkhuyzen et al., 2017). It aligns with the principles of diffusion of innovation theory (Rogers, 2003), as it entails fostering the adoption, acceptance, and application of new ideas, products, or practices spread within a population or social system over time.

Ecosystem restoration, based on Society for Ecological Restoration International and IUCN Commission, 2004.

Ecosystem restoration is a deliberate process aimed at supporting the recovery of degraded, damaged, or destroyed ecosystems to restore their ecological functionality. In MERLIN, it emphasizes freshwater systems, including streams, rivers, peatlands, and wetlands.





1.2 Purpose of Strategy

The Strategy aims to provide recommendations for the agriculture Sector to contribute to the restoration of freshwater ecosystems, by positioning the Sector as an ally in implementing and mainstreaming NbS and by establishing a clear pathway that addresses key issues (see Section 3) while balancing the interests of farmers with those of the broader European society. The agriculture sector and linked agri-food systems need to go through a transformation process in order to support large-scale freshwater restoration using NbS and make the Sector more future-proof through the multiple co-benefits of NbS. The strategy thus aims to support an increased resilience of farming systems in the context of urgent climate and biodiversity crises. While this strategy focuses on the large-scale use of NbS, it acknowledges that other tools, measures, policies and incentives can play an important role in ecosystem restoration.

This Strategy proposes a set of actions, undertaken, facilitated, funded or otherwise supported by a diverse set of actors (see Section 1.3), in the production side, along the value chain, but also from policy, markets and finance, as well as consumers, to mainstream NbS uptake in the agriculture Sector. These actions are planned for implementation between 2025 and 2050. It is targeting diverse actors in the Sector, as well as other related ones, for example food retail and industry and the financial Sector related to it. The Strategy's purpose is to go beyond the business as usual, fostering transformative pathways toward alternative, sustainable futures. Its objectives are as follows:

- → To increase the Sector's resilience by upscaling wetland and freshwater restoration through undertaking interventions, such as maintaining soil cover or creating buffer strips on agricultural lands, at a catchment-landscape scale.
- → To recommend mechanisms (regulatory, technical, political, financial, governance, awareness raising) that are required to enable large-scale upscaling of restoration by the agriculture sector across Europe.
- → to re-shape the role of the public sector in wetland restoration using NbS and encourage involvement of local stakeholders, by changing regulations, providing incentives, and setting enabling conditions to attract private finance for NbS.
- → To transform attitudes in the private sector to investments in freshwater restoration by embedding the concept of "natural capital", i.e., the world's stock of natural resources and ecosystems that provide essential goods and services to humans and the economy, and NbS into the mindsets and activities of different economic sectors.
- → To prepare a set of actions and roadmap for the agriculture sectoral community of practice (CoP) that include actors from the public and private sector, NGO and researchers, to implement between 2025 - 2030 and until 2040 - 2050.²

1.3 Targeted audience

This Strategy is aimed at multiple organisations with an interest in understanding how the agriculture sector could in practice make more of a contribution across Europe to the restoration of freshwater ecosystems. It is particularly directed at stakeholders identified in Section 5 as having a role in its implementation:

- A. Farmers;
- B. Farmers' representatives and organisations at Member State and at European levels;
- **C.** Agricultural advisors and extension services, i.e., organizations that provide knowledge, training, and technical support to farmers;
- D. European Commission services relevant to agricultural policy at European level (DG Agri, DG Env, DG Regio, DG Research);
- **E.** Ministries and authorities relevant to agricultural policy at Member State levels (agriculture, environment, regional and rural development portfolios);
- F. Municipalities and their interest representation bodies;



 $^{^{2}}$ The timeframe was selected to align with MERLIN's regional scalability plans (Ojanen et al., 2024).



- **G.** The general public, especially the young and active age population as they may shape long term consumer demand, policy priorities, and investment trends that influence the sector's direction;
- **H.** European, national and local civil organisations, especially those active in environment protection or nature conservation;
- I. Institutions and individuals of relevant sciences;
- J. Private companies sourcing agriculture products (food and beverage, textile, energy...);
- **K.** Public and private financing institutions.

Among these groups of actors, champions and "front runners" play a critical role as they may embrace opportunities generated by these action points, driving innovation and fostering change. While the media is not explicitly listed as a primary target audience, it can nonetheless serve a vital function in amplifying the opportunities presented by the action points, disseminating their outcomes, and ensuring that the voices of all groups are heard.

1.4 Agriculture Sector Community of Practice as one desirable outcome

A Community of Practice (CoP) refers to a group of individuals with a shared interest or profession who interact regularly to exchange knowledge and experiences to enhance their collective expertise (Wenger, 1998). The aim for the MERLIN Agriculture Sector CoP is to create or reinforce networks of organisations in the Sector, to raise awareness about NbS good practice and standards, share sector-specific opportunities among community members and create ownership, driving the mainstreaming of NbS across the Sector (Schulz et al., 2024). Due to the scale of MERLIN, the focus of the CoP is on engaging influential and strategic institutional actors that articulate and voice broader sectoral interests and perspectives.

In the realm of agriculture, forming CoP becomes a catalyst for fostering collaboration, learning, and the adoption of innovative practices, including NbS. MERLIN has enabled activities that can support the process of creating a CoP, e.g. workshops, field demonstrations, and knowledge-sharing sessions that can facilitate the dissemination of information on sustainable agricultural practices tailored to freshwater restoration and sub- or micro-catchment management. Agricultural communities are vital agents of change when it comes to implementing NbS for sustainable freshwater restoration or sub-or micro-catchment garmers as active participants in the CoP promotes the adoption of NbS. Yet, forming a CoP for the agriculture sector has proven challenging, often due to conflicting economic interests and the complexities of tailoring NbS to their specific contexts (Schulz et al. 2024).





2 Methodology

This Strategy is the result of the continued work inside the MERLIN project since it started running in October 2021, and counts on the expertise of MERLIN partners and their networks. The Strategy is the result of an iterative process between experts and key stakeholders of the agriculture Sector that includes conflicting views. It relies on a diversity of methodological approaches and builds upon previous outcomes from the MERLIN research project. Information was collected from various interactions with key stakeholders, such as interviews and roundtables, from expert discussion. Examples were taken from MERLIN case studies (https://project-merlin.eu/cs-portal.html). Information was primarily collected from the following sources:

- → Desktop reviews that compiled information from existing documentation, within the MERLIN project and from other past or current projects
- → Stakeholder analysis and interviews
- → Two Sectoral roundtables
- → Value-chain and policy analysis
- → MERLIN case studies

Desktop Reviews: Desktop reviews were conducted since 2021 to identify:

- → How and to what extent the agriculture sector understands and influences freshwater restoration;
- → Key challenges and opportunities for transformative restoration of the Sector;
- \rightarrow Key policies and instruments, stakeholders and decision-making processes.

It leveraged a wide range of documents (e.g. reports, position papers and website content) produced by private and public stakeholders of the European agriculture sector, as well as scientific papers.

Stakeholder Analysis and Interviews: Based on the desktop review, a stakeholder analysis was conducted. It enabled us to get, for each of the key stakeholders, insights on:

- → Their stance (e.g. opposition, neutrality or support towards restoration projects);
- → Their level of interest in a restoration project;
- → The way the project is expected to affect them (e.g. positively or negatively);
- \rightarrow Existing relationships that can influence them to change their mind or consolidate positions;
- → Their level of influence;
- → Their visions and future aspirations;
- \rightarrow Challenges that they face within their sector.

The stakeholder analysis led to interviews with key stakeholders (Vítkovám, 2022). The interviews allowed us to co-develop an understanding of how and what the agriculture sector needs to participate in mainstreaming NbS and restoration of our freshwaters in Europe. The interviews also provided knowledge and awareness of each stakeholder regarding the restoration issues addressed within MERLIN. To do so, a semi-structured qualitative interview was conducted for approximately 60 minutes.

Roundtables: Two online roundtables (two hours, each) were organised in June 2023 and in June 2024, based on the stakeholder analysis. EU-level representatives from policymaking, production, and research, along with farmers' associations, the agricultural business sector, NGOs, and scientific institutions, as well as partners from the MERLIN project, were invited to participate in the roundtable discussions (see annex for details). Roundtables reports can be found <u>here</u>.

The first roundtable discussed the main obstacles and opportunities of mainstreaming NbS on three spatial levels, namely farm, in sub- or micro-catchment areas and on river catchments. This roundtable was carefully designed to ensure respectful social learning focussed on improved mutual understanding, opportunity sharing and good practice generation. 19 people representing diverse stakeholders within the agriculture sector participated, in addition to two moderators and two notetakers (see annex for list of participants). An online questionnaire was also developed to complement the roundtable to understand the perceptions, understanding and challenges that the





Sector faces in relation to NbS and freshwater restoration. A brief summary report was later produced and shared with participants.

The second roundtable was held in June 2024. While a number of representatives from the EU Commission (DG AGRI, DG Environment, DG Research) were present and the top-down measures of river restoration were discussed in the first roundtable, in the second one more NGOs were present such as ELARD, SMART City, Rural Pact (see Annex for list of participants) and bottom-up approaches got more attention. This second roundtable built upon the draft of the agriculture Strategy of MERLIN, highlighting the six actions/recommendations of the Strategy.

Policy and value-chain analysis: An in-depth analysis was carried out of the current support to freshwater NbS offered by the EU Common Agriculture Policy 2023-2027 (Blackstock et al., 2023). The Catalogue of CAP interventions was exploited to extract information on the farm practices supported by CAP funding instruments (e.g. conditionality, eco-schemes, climate and environmental interventions under rural development), and the broader design and implementation logic of these interventions including budgeting and eligibility criteria (Rouillard et al., submitted). This analysis was complemented by assessments of CAP implementation and lessons learned through the CAP Rural Network activities³, as well as ongoing policy discussions on the future of the CAP to draw out recommendations on the improvement of the agricultural policy to better support the uptake of freshwater NBS.

A value chain analysis was conducted to examine how the NbS can be mainstreamed within the agriculture value chains (Chen et al., 2024). It provided good practice examples that also fed into the expert discussions, e.g. during the 2nd roundtable.

MERLIN case studies: MERLIN case studies with a strong focus on agriculture provide further practical evidence about enablers and challenges shaping the role of the agriculture sector in freshwater restoration. While <u>six MERLIN case studies</u> are strongly connected to agriculture, three of these cases are considered in this strategy:

- → Case study 09 (Tisza floodplain rewetting HU)
- → Case study 16 (Upper Scheldt restoration BE)
- → Case study 17 (Forth basin restoration UK)



³ https://eu-cap-network.ec.europa.eu/index_en



3 Why is change needed?

3.1 What is the relationship between agriculture and MERLIN?

MERLIN aims to facilitate the integration of NbS into freshwater restoration efforts. Agriculture, due to the extensive land it occupies and the management practices employed, has a substantial impact on much of the EU's freshwater ecosystems. This influence extends to water chemistry, ecology, and hydromorphology.

Agriculture is particularly relevant to freshwater restoration in cases where **agricultural production takes place on former floodplains or drained wetlands**. Agricultural activities can generate chemical pressures, destroy habitats (e.g. wetlands), and cause hydromorphological changes such as canalization and embanking, which reduce the drainage and infiltration capacities of freshwater ecosystems. However, agricultural production is **highly dependent on climate, water, soil conditions, and biodiversity.** Incentives thus exist for farmers to adopt interventions that enhance the resilience of production systems.

While interventions can range from fully green to fully grey via hybrid solutions, this strategy focuses on NbS interventions. These interventions are emphasized because they demonstrate a clear mutual benefit by simultaneously supporting farmers and enhancing biodiversity, thereby forging a strong link between agricultural practices and freshwater ecosystem restoration. Some interventions, though implemented on the farm level, may provide ecological and economic benefits downstream.

Numerous NbS options can be applied to agriculture, with examples available at www.nwrm.eu. While some NbS are relatively straightforward, logical, and cost-effective to adopt, others may present challenges. For instance, interventions requiring **land sparing** (reducing cropped areas) or **land sharing** (restricting activities to less profitable uses) may encounter resistance, even when supported by public funding incentives (Gumiero et al., 2013).

3.2 What is the current problem?

Untenable burdens on freshwater ecosystems

Human society is operating well outside the "safe operating space" with the potential for widespread environmental degradation and the endangerment of human welfare (Rockstrom et al., 2009; Fig. 1).









Figure 1: The 2023 update to the Planetary boundaries. Licensed under CC BY-NC-ND 3.0. Credit: Azote for Stockholm Resilience Centre, based on Richardson et al.,2023.

In the analysis by the European Environment Agency (EEA) of the Drivers of change of relevance for Europe's environment and sustainability (EAA, 2020b) the seriousness of breaching these planetary boundaries is spelt out (our emphasis):

p7. "The global risks report 2019 by the World Economic Forum, **environmental risks** accounted for **three of the top five** risks ranked by **likelihood** and **four of the top five** risks ranked by **impact** (WEF, 2019). **Despite international agreements** — such as the Paris Agreement, Aichi biodiversity targets and the Sustainable Development Goals (SDGs) — **current trends** indicate that these challenges are likely to **worsen** in the future, unless a fundamental **reconfiguration of production and consumption systems** occurs at the global scale".

Agriculture as a driver of degradation of freshwater ecosystems

The agricultural sector in Europe is highly diverse, encompassing a wide range of farm types (Fig. 2.A) and business sizes. However, in aggregate, it faces common challenges due to the significant environmental pressures it imposes on freshwater ecosystems (Fig. 2.B).







Figure 2. A. Distribution of main farm types per NUTS3 Europe, computed from businesses counts. B. Cumulative agricultural pressure index computed as the average intensity of multiple agricultural pressures (nutrients, pesticides, water abstraction, hydromorphological alterations) on European water bodies. Sources: Schürings et al., 2024.

Agricultural production is one of the drivers of degradation of freshwater ecosystems (Moss, 2008). Practice of agriculture – both the mix of activities and the intensity of production (types and volumes of inputs) negatively impact the ecosystem, including natural habitats, soils and groundwater. Less than 40% of **surface waters** in Europe are classified as being in good or high ecological status, and overall ecological improvement has been stagnant since 2009 (EEA, 2024a). The agriculture sector, one of the largest pressures on freshwater ecosystems, shows little signs of abatement (EEA, 2020a; 2024). In 2019, the Sector accounted for 59% of total freshwater consumption, and agricultural runoff – particularly from nutrients and pesticides – had a substantial impact on water quality, affecting 22% of surface water bodies and 28% of groundwater areas in Europe (EEA, 2024a). Additionally, changes to the physical characteristics, structure, and processes of water bodies, while only partially driven by agricultural drainage and irrigation, significantly impact 34% of European surface waters (EEA, 2024a).

Reporting under the EU nature directives 2013-18, as presented in the 2020 State of Nature in Europe, a health check, highlights the complex and interacting set of drivers contributing to **biodiversity loss** (Fig. 3; EEA, 2020b). Agriculture is the most frequently reported pressure (21%) but with negative effects of both loss of habitat from intensification but also from land abandonment. Where pollution is the driver (of air, water and soil degradation) then agriculture is linked to 50% of all pressures. The outcomes of such pressures are that only 14% of habitat assessments and 27% of non-bird species are good, with pollinator habitats having worse status and trends than others.





Agriculture has caused severe **soil degradation**, e.g. due to excessive use of chemical inputs, monoculture cropping, and drainage of peatlands. Degraded soil can infiltrate and retain less water (Basche and DeLonge, 2019) and soil loss caused by erosion puts more and more sediment, nutrients and pesticides into the surface water flows (Ulen et al., 2007) negatively affecting biodiversity. 60-70% of soils in Europe are estimated to be unhealthy (European Commission, 2021). In turn, soil degradation is shown to be deeply related to agricultural productivity (Barbier & Hochard, 2018), food security (Prăvălie et al., 2021), and environmental sustainability (Borrelli et al., 2023). Particularly, healthy soils play an important role in regulating natural disasters such as floods and droughts (Saco et al., 2021), which society needs preparedness for in an era of climate change.

Farmers and policy makers have recognised the **negative externalities** of **conventional intensified farming** (soil and biodiversity loss, GHG emissions and harm to other ecosystems such as lakes and rivers), and these are either seen as necessary to maintain access to low-cost food or as the price of doing business.

Pressures	Nitrogen surplus	Phosphorous surplus	Pesticide	Veterinary medicines	Water use	Hydro- morphological
Extent of current agricultural pressure	49 kg N surplus/ha of agricultural land	1.2 kg P surplus/ha of agricultural land	335 870 t active substance	72.6 t active ingredient	50 km ³ of water abstracted by agriculture	34 % of SWB affected
Main sources and activities	Fert	ilising	Application of pesticides	Veterinary antibiotics used in livestock breeding	Irrigation	Livestock trampling, drainage, water storage
	AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA	中中中中			+	lin -
Measures						
Efficient nutrient	use O	0				
Pest and disease managen	nent		0	0	2	0
Water use efficie	ency	0	0		0	0
Soil managen		0	0		0	0
Livestock managen	nent O	0	0	0	0	0
Landscape approa	ches O	0	0	0	Ĵ	õ

Figure 3: Agricultural pressures on water systems and possible responses to these pressures through measures on resource use efficiency (e.g. improved feed, manure management), soil, crop and livestock management (e.g. reduced tillage or no till, strip cropping), and landscape approaches (e.g. buffer strips, floodplain restoration). Source: EEA, 2020a relevant to the <u>Strategy</u>. Other measures are touched upon, e.g.

efficient nutrient/water use in action 5, but are not much developed in this strategy.







Policy responses

The greening of the Common Agricultural Policy and several European strategies, e.g. the Green Deal, Farm to Fork and Biodiversity strategies, are increasingly supporting, at least rhetorically, the transition towards sustainable agri-food systems by aiming at improving the environmental performance of European agriculture. The agriculture sector receives a large amount of EU funds through the Common Agricultural Policy (EIB, 2023), i.e. 31% of the EU budget. Although income support is the main objective, the CAP can be used to support soil regeneration, micro catchment co-operations aiming at water retention and creating wetland areas within the farmed areas. However, the effectiveness of greening policies for agriculture depends on the willingness and knowledge of the farmers (Pe'er et al., 2022; Blackstock et al., 2023).

The interpretation of the EEA analysis within this Strategy is that **business as usual will not be sufficient**, and that systems of land use and water management need to change both within Europe and in the way that Europe interacts with other regions (EAA, 2020b). Despite the EU responding to challenges (e.g. via the Green Deal) these "*persistent problems* resist traditional policy responses, as they are intrinsically linked to unsustainable but well-established patterns of production and consumption", with food production (agriculture) the first of three sectors highlighted (EAA, 2020b p14). Here the key insight is that progress is being limited by "lock-in" that requires systemic change. While such changes are never politically easy to enact, industrial history highlights that social licence to operate has profoundly changed over time, limiting the harm from the production practices of most industries. The EEA concludes that land and water management will adapt when changes are seen as "ijust' and 'fair' transitions" (EEA, 2020b, p14). This Strategy thus attempts to set out a pathway that makes a clear statement of the issues and balances the interests of land managers against those of wider European society.

Vulnerability of the agriculture sector to the global environmental crises

The agriculture sector faces escalating environmental and socio-economic challenges expected to intensify in the coming years. The effects of the ongoing environmental crises on the Sector will impact food production and peoples' livelihoods, compromising food security globally. With **climate change**, temperature and precipitation patterns have drastically changed (IPCC, 2023). This has impacted the natural resources the agriculture sector depends on (IPCC, 2023). Climate-related hazards (e.g. heatwaves, prolonged droughts and floods) in interaction with non-climatic risk drivers (e.g. landscape fragmentation, pollution, unsustainable agricultural practices and water management, land use and settlement patterns, and social inequalities) threaten Europe's food security, public health, ecosystems, infrastructure and economy. Cascading climate risks can lead to system-wide challenges affecting whole societies, with vulnerable social groups particularly implicated.

Water scarcity conditions persisted across 29% of the EU territory in 2019 (EEA, 2022) and half of the EU population lives in water-stressed countries (EEA, 2022). Southern Europe is particularly vulnerable, while in most countries, water scarcity conditions are most intense between July and September. Increased competition with other sectors, e.g. tourism, over scarce water resources can compromise food production and security (EEA, 2022). Reliance on groundwater for irrigation is a growing issue (Madrid et al., 2013).

Biodiversity is intricately linked to agricultural production. Above and underground diversity is a vital component of healthy and resilient agroecosystems. Climate-induced changes, coupled with intensive agricultural practices, and related pollution pose significant threats to agroecosystems, riparian and aquatic ecosystems (Yang et al., 2024). These threats result in loss of pollination, soil engineers, and natural pest control that, in turn, affects agricultural yields.

While a majority of European **soils** are in poor condition, soil degradation has been shown to be deeply related to agricultural productivity (Barbier and Hochard, 2018), food security (Prăvălie et al., 2021.), and environmental sustainability (Borrelli et al., 2023). Particularly, healthy soils play an important role in regulating natural disasters such as floods and droughts (Saco et al., 2021), which society needs preparedness for in an era of climate change.







Need for a systemic approach

Given the critical role of nature in providing essential ecosystem services for human well-being, the need for the transformation of agricultural systems within Europe is urgent. Farmers can play a pivotal role in driving ecosystem restoration, as they can integrate their local and traditional knowledge with new expertise to safeguard the ecosystems that underpin food production. NbS interventions often provide **solutions to multiple, complex societal challenges** (de Knegt et al., 2024) while enhancing the resilience of agricultural systems.

While NbS has gained significant attention in political discourse and offers opportunities for scaling up to address challenges in agri-food systems, **several barriers remain that hinder their adoption** in agriculture globally. Budding-Polo Ballinas et al. (2022) have identified five important categories of barriers were identified: 1) Financial barriers; 2) Perspective and opportunities for farmers are lacking; 3) A lack of shared vision between governments and with other stakeholders; 4) Knowledge-related issues in education, knowledge sharing and local knowledge from actors who could implement or support the implementation of NbS; 5) Resistance to change.

The MERLIN project responds by proposing an **agriculture Strategy that makes suggestions for mainstreaming of NbS within the Sector**, seeing land managers as indispensable in implementing NbS while recognizing that there can be significant reluctance and socio-technical barriers to their participation (Miralles-Wilhelm, 2023). These NbS seek to reduce negative externalities, e.g. pollution, restore or better manage riparian habitats and aquatic environments and generate new revenue streams for land managers and others in the river basins. The Strategy recognises the need for **multi-scale** (field-farm-catchment) and **multi-actor** cooperation (private, government and third-Sector) and the need for **wider society** to be better informed so that NbS are the "new-normal" such that the complex, contested issues can be addressed in ways in which the best knowledge is used to help generate outcomes that can be seen as fair and equitable.

3.3 What is the Sector's role in resolving these problems?

The agriculture Sector can significantly contribute to upscaling freshwater ecosystem restoration through implementation of NbS

The agriculture Sector is a critical and essential ally in contributing to freshwater ecosystem restoration and helping lower climate and biodiversity related risks by implementing a wide variety of measures, including NbS (Miralles-Wilhelm, 2023), due to its spatial extent, its dependency and its impacts on ecosystems. Land use and agricultural management influence the soil hydraulic properties including water retention (Moret-Fernández et al., 2021) in different ways at floodplain, micro- and sub-catchment and plot and farm levels (Box 2).

At the floodplain level, agriculture has a very relevant role in **ensuring land availability** for the implementation of large-scale floodplain restoration interventions. Agricultural areas occupy 60% of European rivers' floodplains (Entwistle et al., 2019). Healthy floodplains, i.e., floodplains that serve hydrological, ecological, and societal functions, have been shown to provide an alternative to structural interventions for flood protection, while supporting improved water quality, conditions for biodiversity conservation and recreational value (EEA, 2019). Recovering less than 2% of the overall cropland area in Europe's floodplains as flood retention areas would reduce flood damage of floods would be reduced by 83% in economic terms and by 84% in the population exposed by the end of the century and under a 3°C global warming scenario (Dottori et al., 2023).

The agriculture sector also has a role to play **ensuring room for the river** (partial land availability) in certain periods of the year. River restoration as a NbS often requires allocating some of the farmland to permanent or temporarily flooded areas, or transforming conventional farming practices or crops to be compatible with temporarily flooded areas. This requires innovation in finding new ways of farming compatible with providing room to rivers and wetlands (example in Box 3).







At the micro- and sub-catchment level, the Sector can also undertake a major role in restoring the **surface water flows and related freshwater ecosystems** to ensure natural water retention at microor sub-catchment level. It can be achieved e.g. by creating a network of landscape elements.

At a finer scale, the agriculture sector has a very relevant role in **restoring soil, enhancing water retention and water quality**. The Sector, especially the intensive crop production, has potential to fully restore soil ecosystems in order to reduce water pollution with no or less use of pesticides, and maximise the infiltration and storage of precipitation and to minimise soil erosion.

Implementing NbS that support soil and ecosystem restoration benefits society by enhancing the provision of multiple public goods and ecosystem services. While increasing ecosystem service delivery through NbS can sometimes reduce agricultural yields and, consequently, individual farming profits (Jones et al., 2023), some studies highlight synergies between food production and environmental benefits (Tamburini et al., 2020). The potential or perceived trade-offs between agricultural production and other ecosystem services require further research to comprehensively evaluate costs and benefits for farmers and innovative financing and regulatory mechanisms are needed to compensate for potential yield losses.

Box 2. Examples of interventions for the agriculture sector at the three spatial levels (plot, micro- and sub-catchment and floodplain; WG PoM, 2014)

Interventions for the agriculture Sector to restore and enhance freshwater systems play out across multiple spatial levels, ranging from the plot and farm levels to the micro- and subcatchment and floodplain levels. These efforts require collaboration among diverse stakeholders and require multi-level governance support to ensure effective implementation and long-term effectiveness

Plot and farm levels:

Interventions at plot and farm levels can **enhance many ecosystem services:** they can reduce surface water runoff, increase soil water retention and groundwater recharge, enhance carbon sequestration and natural pest control. They can directly benefit farmers thanks to increased soil productivity, possible reduced input costs and increased resilience to climate stress (e.g. droughts or excessive rain). Such interventions include less intrusive tillage practices, use of soil cover crop and long crop rotation practices.

(Sub)catchment level:

Interventions at (sub)catchment level can contribute to **restore surface water flows and related freshwater ecosystems** by focussing on slowing the runoff at the landscape or catchment level. This can be done by creating a network of buffer strips or edge-of field trenches (Vought et al., 1995; Heinen et al., 2022), which need to be implemented by a wider consortium of landowners in order to be effective.

Floodplain / river level:

Interventions at the river level through e.g. reconnecting floodplains can **restore the functioning floodplains of bigger rivers**, by removing barriers that hinder their natural connectivity and recovering their functionality to buffer floods and retain water (Roley et al., 2012; Llobet et al., 2022), which need to be implemented by a wider consortium of landowners in order to be effective.

Critical need for local cooperation, institutional, policy and financial support

Effective interventions, especially at the sub-catchment and floodplain levels, may require learning and active and positive participation in local cooperation between all related land users (Fliervoet et al., 2013; Watson, 2015), for which financial, informational and social-process support is crucial. Ideally a local organisation with sufficient administrative, animation and management capacities, as well as local geographical, agricultural and social knowledge can best initiate, enhance the





formation, and operate such local co-operations. It includes extra efforts like giving up arable areas, providing buffer zones to protect ecological functions, voluntary work, maintenance and monitoring tasks.

While the Agriculture sector has been identified as having great potential for supporting freshwater restoration, e.g. through the upscaling of NbS, its critical role is dependent on transformation of the Sector. The transformation relies on changes that may vary across stakeholders within the Sector, and in particular, between different types of farming systems (Stringer et al., 2020). These changes may require institutional and financial support, such as Payment for Environmental Services (PES), a coherent regulatory framework, or removal of perverse subsidies (Stringer et al., 2020).

The institutional and financial support is particularly critical, as changes in the Sector may raise potential trade-offs with productivity and production (Meyfroidt, 2018). By adopting NbS, farmers may have to give up land or change crops in certain areas. Additionally, a shift away from large-scale intensive production may affect the dynamics within the Sector. For instance, large transnational agribusinesses and food supply chains, supported by consumer demands, tend to favour larger-scale producers (Stringer et al., 2008), making access to market for alternative farming difficult (Stringer et al., 2020).

Institutional support can also contribute to more efficient financial support to farmers willing to transform their practices, as policies encompass rules for meeting the demands of society towards food. Meeting such demands often implies higher costs for the farmer, calling for a fairer price reflecting the services farmers provide to society at large when implementing NbS (Baltussen et al., 2018), ensured by supportive, long-term oriented policies in place (Van der Meulen et al., 2020).

Companies buying agricultural products have a role to play in complying with current regulations and potentially exceeding them. This includes supporting fair pricing mechanisms and encouraging their suppliers in the agricultural sector to implement NbS and landscape interventions as part of broader sustainability initiatives. Providing technical and financial support to facilitate these actions can contribute to reducing supply chain risks and enhancing social acceptance.

Mechanisms could be established to support such changes to minimise the trade-offs. In particular, new practices could be implemented to compensate farmers for potential (temporary) yield and financial losses. Resources to make this happen could come through CAP subsidies, a higher recognition from the market or the creation of new value chains - either for new agriculture products or for new resilience services (Payment for Ecosystem Services schemes), like buffering the impacts of floods, for example Weikard et al., (2017).





Box 3: Alternative uses for restored floodplains - Example of the Tisza floodplain rewetting (Case study 9.), Hungary

Tisza floodplain rewetting (Hungary)

Data from MERLIN Tisza case study on floodplain rewetting have been used to model the potential of upscaling floodplain restoration. The implemented NbS measures would allow the recovery of up to 26,000 hectares of temporarily flooded surface (Koncsos et al., 2006). Part of that area would still be suitable for agriculture (grazing, haymaking, wetland uses, orchards), and forestry and could produce green biomass for electricity production from biogas.

Floodplain restoration therefore shows potential to buffer floods and droughts, enhancing biodiversity, while producing diverse crops, energy, and providing an income to the agriculture sector.



Photos: Bereg and Nagykoru (Tisza river) taken by Peter Kajner (WWF Hungary)

Restoring river floodplains can result in permanent or temporary flooding of land which was formerly used as arable or grazing land (Serra-Llobet et al., 2022). Temporary flooding allows for extensive grazing, but also for certain perennial cultures adapted to the water cover conditions (Bellon, 2004; Flachner et al., 2010). New promising technologies allow for the use of perennial plants or diverse mixed crops without tilling and chemicals to produce green biomass.

Green biomass can be used as fodder or can be processed into protein and other types of products, such as flavonoids, and residues could be used for biogas production -that would allow to bridge gaps in renewable energy production (European Commission, 2019). These new products imply new value chains developed linked to restoration areas, pioneering in green transition of agriculture, and helping accelerate the mainstreaming of river restoration.

3.4 What is the focus of the Strategy?

Given the challenges and opportunities related to the agriculture sector, the Strategy focuses on six strategic actions (#) related to plot/farm, micro-/sub-catchment and/or floodplain levels: (#1) **Engaging and assisting land users to adopt NbS**, (#2) **increasing public support**, (#3) **improving policy and regulatory framework**, (#4) **initiating landscape partnerships for multi-stakeholders coordinated restoration**, (#5) **accelerating relevant innovation**, **and** (#6) **strengthening market and financing market mechanisms** (Fig. 4). These are interconnected actions for the stakeholders from the agriculture sector and non-EU and EU Member States policymakers to implement between 2025 - 2030 and until 2040, 2050.

The first phase of MERLIN work identified potential cooperation points between the project and the agriculture Sector. It focused mainly on creating an enabling environment that can support coordinated or collective action across farms and help farmers benefit from adopting NbS (Box 4;





Bérczi-Siket et al., 2023). While these cooperation points have been refined and focused, they are used as starting points for this strategy.

Box 4: Cooperation points summary. Source: Bérczi-Siket et al.,2023.

MERLIN's report on sector briefings for freshwater restoration highlighted three main cooperation points with the agricultural sector to mainstream NbS:

Illustrate the benefits of NbS, including

- Mapping/modelling how NbS impacts the agricultural business models in a landscape context (e.g. risk reduction, effects on yield change) by screening restoration needs by farm type could be a first step to see how NbS interact with business objectives;
- Sharing successful case studies (learn from MERLIN case studies, their twins, and others), covering different realities (and challenges for the sector) across Europe.

Build capacity and knowledge sharing opportunities, including

- Developing consortia models to bring together stakeholders often working separately, e.g. resource managers, farmers, value-chain operators, policymakers;
- Sharing information about the practical / technical aspects of implementing NbS.

Adapt or create policies and products, including exploring

- Insurance schemes that would cover farmers for loss due to allowing their land to absorb water during extreme climate events occurring as part of the NbS;
- The implementation of eco-schemes to organise collective action to implement NbS in a group of farms;
- A NbS certification as an add-on module to organic certification or stand-alone certification. The use of certification would allow farmers to be acknowledged for adopting NbS.

Support policy development so that NbS is well integrated into the CAP and related Country Strategic Plans.

Based on the four cooperation points (Box 4) and the work MERLIN is developing, the present Strategy focuses on three approaches (Fig. 4):

- Building knowledge of NbS and their benefits: provide examples on NbS cases and their impact, ensure on-ground support to farmers, ensure and foster innovation for a new way of farming, more resilient and sustainable. [Actions 1, 4, and 5]
- → Create new finance and policy mechanisms: ensure CAP and other EU policies provide appropriate support, while identifying new value chains for agriculture produce linked to NbS implementation, or for ecosystem services provided by the Sector by implementing NbS interventions. [Actions 3 and 6]
- Ensure recognition by the society: communicate the role of farmers as resilience builders when working with nature, as a way to ease and promote the design and implementation of supporting policies, as well as the support of other actors in the agri-food system - e.g. retailers and industry. [Action 2]

The Strategy is envisioned as a starting point for these cooperation points that will further develop after the project MERLIN finishes. Some next steps to this strategy are suggested in Section 7.







Figure 4: Summary of MERLIN's proposal of agriculture Sector Strategy for NbS mainstreaming. The six strategic points listed on the upper right corner are further developed in Section 5



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4 What is the vision/goal of the Strategy?

Building on the challenges and opportunities in Section 3, the Strategy for the Sector to mainstream NbS aims to support the **transformation of the European agriculture sector.** It is underpinned by a transformation framework, as elaborated by Carmen et al., (2024). While a smooth and gradual transition is preferred by land managers, the current emergency situation already demands a transformation (Fig. 5).

The transformation process recognises that the problems within the current system are an outcome of the interactions between **Personal**, **Practical** and **Political** (PPP) elements that combine to create a **Socio-Institutional Context** where ecosystems are undervalued and allowed to deteriorate. Personal elements are individual and shared subjective assumptions, values, beliefs and paradigms which guide how people perceive issues, how problems are defined and what is and is not possible/ relevant. Practical elements are technical, technological and behavioural aspects. Political elements are structures, processes and mechanisms that facilitate or constrain decision making and collective action. Transformational change requires a mix of actions (that will vary between locations) that seek to address these key PPP elements. **Creating Actions** seek to bring in new ways of thinking about the system as a precursor to changes in the ways activities are undertaken. **Maintaining Actions** seek to recognise desirable features of the current system, to ensure they persist and to exploit them as demonstrations of what can be achieved. **Disrupting Actions** recognise that there can be factors that "lock-in" undesirable patterns of activity as the social norm and limit expectations of what can be achieved, these need to be challenged.



Figure 5: Transformation Framework. Adapted from Carmen et al., (2024).

The strategy envisions a pathway to a transformed agriculture Sector that mainstreams NbS into its practices, fostering resilient, appropriately productive, sustainable, and interconnected farming systems. EU agriculture will deliver high-quality food, while operating within planetary boundaries, with a firm commitment to achieving both intermediate (by 2030) and longer-term (by 2050) targets for climate change mitigation, adaptation, and biodiversity recovery. Farmers and farming systems will be recognized and rewarded by citizens and markets for their dual roles as food producers and ecosystem stewards.

To institutionalize these changes, the strategy outlines six action points, phased from 2025 to 2050. The vision implies that NbS are clearly defined for agriculture and understood by farmers and are part of regular farming practices (NbS are now normal practices, i.e. mainstreamed). Farmers work with and for nature using regenerative and nature-based methods to continue to generate high quality food while reducing pressures on, and enhancing the state of, the associated aquatic





environments. The Sector operates within the planetary boundaries, e.g. prioritising natural water retention interventions instead of new grey infrastructure development. Farming systems are resilient, productive, and sustainable and connected with each other, and produce healthy and nutritious food. Farmers are recognized and rewarded by society when they act as providers of both food and enhancing the provision of public goods and services. Farmers have a level playing field by ensuring that pollution does not pay, initially by support and advice but where necessary by enforcement of EU and MS regulation as an expression of social licence to operate. By acting at plot and farm level, and cooperating across catchments and landscapes, farmers make a positive contribution to solving crucial societal issues. The connection of society to agriculture, and more broadly to rural landscapes and activities, is tighter with shortened value-chains, and fairer producer prices. The synergies between land users across regions and scales (e.g. rural-urban) for water-related management is recognised and valued. Networks of farms allow farmers to have the opportunity to share their knowledge (of opportunities and good practice) among peers (other farmers) and to be engaged in a collaborative/collective management of the water catchment or of the landscape.

This vision acknowledges the variability among production systems and regions. While the transformation of some systems may depend on adopting fewer intensive practices, it recognizes that production in certain areas may need to be constrained by resource availability (e.g. water scarcity in parts of the Mediterranean region). Conversely, other areas could achieve higher productivity within the boundaries of local environmental constraints through improved technical efficiency.

Specific objectives of the Strategy are:

- → The main stakeholders of land use farmers, municipalities, policy makers fully understand the state of the freshwater ecosystems including soil health and adopt the need to restore them, e.g. by applying NbS.
- → The public is aware of the state of water ecosystems and soils and its link to agricultural practices and market demands, and they agree on the need to restore them, e.g. by applying NbS, so that a critical mass is formed to initiate changes in public policy.
- → The regulatory framework is allowing and promoting the use of NbS and related necessary collective action, including the CAP rewarding actions with clear ecological benefits and providing sufficient direct funding assistance to restore freshwater ecosystems and improve soil management.
- → A knowledge base is available, consisting of experts, practitioners and guidance about practical methods on how farming practices can be adjusted to contribute to restoring freshwater ecosystems. Responsible national and local organisational structures are encouraged to coordinate the cooperation of farmers, municipalities and authorities in restoring freshwater ecosystems by NbS.
- → Favourable innovation climate for topics that are aimed at supporting new agricultural production systems, products and related technologies moderating or solving the conflicts between applying NbS and food production.
- → New value chains are in place that reward the implementation of measures that stimulate/contribute to ecosystem restoration, through new products, fairer prices or by the establishment of Payment for Ecosystem Services Schemes.

The next section explains how the strategic actions will generate progress towards delivering the overall vision for a transformed relationship between agriculture and the freshwater ecosystems, considering the diversity of farming systems within an area. These strategic actions can be seen as general preconditions that need to be fulfilled before the specific actions can take place within Sector, considering its diversity within and between production systems and along the entire value chain.





5 Strategic actions

Six key action points were identified: **engaging and assisting land users to adopt NbS, increasing public support, improving policy and regulatory framework, setting up knowledge sharing capacities, initiating landscape partnerships for multi-stakeholders coordinated restoration, accelerating relevant innovation, and strengthening market and financing market mechanisms**. These action points come as elements of response to the issues highlighted in Section 3 and the specific objectives stated in Section 4. They are also aligned with the key blocking mechanisms that hinder the adoption of NbS in agriculture by Vermunt et al., (2022) and Budding Polo-Ballinas et al., (2022) (see Section 3.2).

5.1 Action 1: Engaging and assisting farmers to adopt NbS

Description of the action

Inadequate knowledge of how to implement NbS and of their potential benefits can hinder their uptake and mainstream by farmers (Chappin et al., 2024). This can be compounded by antagonistic political narratives that can lock land managers into negative group-thinking that may even be actively disadvantageous to them in the medium or longer term. An improved understanding of NbS and their benefits to resilient farming systems and society as large is needed. This action aims to **ensure the successful implementation and adoption of NbS by farmers, by providing the farmers with access to knowledge and information** that are reliable and relevant on NbS explaining the costs and benefits.

It is necessary that farmers, and authorities at all levels as well, need to be informed about the current condition of aquatic ecosystems, including soil health and where they can significantly contribute to restoring these ecosystems by the implementation of NbS. They should also be informed about the methodology, pathways and support opportunities to implement such interventions. In order to support the implementation of NbS in a consistent manner that links with current and potential farming practices, specific actions include:

- → Provide evidence, through simple materials, to farmers on the current situation of environmental degradation and the role of the Sector in the state of natural resources on the farm and beyond.
- → Provide alternative practices to current intensive crop production that are adapted to restored wetlands and peatlands, including alternative crops, extensive grazing systems and cultivation methods, potential new value chains (aquaculture, eco-tourism, etc.) and innovative biomass-based products (leaf protein; Box 5. and action 5.) actions to apply NbS for restoring small catchments.
- → Showcase good practice examples in relevant case studies demonstrating the successful integration of NbS into farming practices (see Box 6 for an example from a MERLIN case study).
- → Provide evidence of **benefits of NbS**, in terms of **multiple ecosystem services and increased resilience** of farming systems, in the short and long term, and in particular, providing clear examples, analysed on how NbS impacts the agricultural value chains, and business models. Explanatory information materials on the benefits and a collection of convincing examples in the form of comparative studies on characteristic cases for the main agro-ecological regions, before and after restoration. Cost-benefits analysis provided by MERLIN for selected cases (e.g. the Rhine river branches (Kok et al., 2025), and Forth catchment) could contribute to first evidence on local and regional scales.





Box 5.: Alternative cultivation methods adapted to restored wetlands and peatlands - Paludiculture. See for example European projects PRINCESS, funded by the European BiodivERsA programme.

Paludiculture, the cultivation of crops on wet or rewetted peatlands, presents a sustainable land-use alternative that combines productive agriculture with wetland ecosystem restoration. This approach enables farmers to generate direct income by cultivating plant species specifically adapted for paludiculture. Unlike conventional agriculture, paludiculture produces biomass from wet or rewetted peatlands while preserving the underlying peat layer. This not only supports peat accumulation but also maintains the ecosystem services provided by peatlands.

The biomass harvested from rewetted peatlands has diverse applications. For example:

- Reeds (*Phragmites australis*) can be utilized to produce fire-resistant boards or insulation plaster.
- Cattail (*Typha spp.*) is a highly productive species suitable for use as a construction material, fodder, and biogas production.
- Water fern (*Azolla filiculoides*), rich in proteins and lipids, is ideal for both food applications and biofuel processing.
- *Sphagnum* moss biomass serves as an eco-friendly alternative to peat in professional horticultural growing media.
- Grasses such as tall fescue and reed canary grass have demonstrated high biomass yields and offer additional potential for sustainable utilization.

Roles and responsibilities

Target groups (letters refer to the ones listed in Section 1.3):

A - Farmers, as active participants in NbS implementation practices, should share their results and experiences with other farmers and document the impacts of practices by observing outcomes (e.g. soil health, water retention, soil erosion). They should also provide local evidence through demonstration projects and participate in farmer to farmer networks to share practical insights.

B - Representation bodies and organizations at European and Member State levels such as agricultural chambers and farmer associations are responsible for providing farmers with simple materials, training programmes and sessions, and practical examples to support NbS adoption. They should also connect research institutes and farmers to ensure that guidance and evidence are disseminated effectively.

E - Municipalities and their interest representation bodies: Municipalities, as local authorities, are responsible for providing locally relevant information about land use, water management and natural resource protection, to ensure that the guidance fits the local ecological and water management conditions. Their interest representation bodies can facilitate the exchange of practical knowledge, show successful examples of NbS in action, and can provide logistical or technical support to farmers.

Timing of the action

This action that aims to engage and assist farmers in the agriculture sector to adopt NbS should be proposed to implement between 2025 - 2030, with ongoing efforts that would extend to 2040 and 2050. This timeline can allow for the gradual integration of NbS into farming practices.







Important differences between Member States and regions

Because of different geographical, climatic and socioeconomic conditions that vary between European Member States, the agriculture sector is diverse, and this requires that evidence and provided guidance to be tailored to specific regional contexts. This should consider variations in farming system, land use and freshwater challenges, to make practical and effective solutions, considering local needs.

Monitoring the effects of the action

To effectively communicate the outcomes of NbS interventions there needs to be a long-term commitment to monitoring the NbS undertaken by innovators or early adopters as this provides the credible evidence base on which decisions can be made. An example of a relevant monitoring framework is provided in MERLIN's <u>Deliverable D.1.2</u>, that includes environmental indicators (e.g. biodiversity, greenhouse gas emissions, water storage capacity) and socio-economic indicators (e.g. stakeholder representation, private finance mobilization, job creation).

Implementing Before-After-Control-Intervention (BACI) design can provide robust evidence and attribute observed changes directly to the restoration measures. This will involve comparing data from before and after NbS implementation.

Summary of action

This action aims to better inform farmers considering integrating NbS for water retention, and soil health but also for biodiversity improvement, and pollution reduction, into their farming practices, to increase resilience in the farming system and deliver ecosystem restoration. By recognizing farmer's critical role as land managers, the action seeks to address knowledge gaps between farmers and the implementation of NbS by providing accessible and practical information, demonstrating NbS benefits to farming systems, through direct engagement with farmers.







Box 6. Example of <u>Case study 16. Upper Scheldt restoration</u>. While this Case illustrates here the action 1 on engaging farmers, it is also related to several other actions, such as actions 4 and 6.

The restoration of the Zwalm River basin is one of the MERLIN case studies, focusing on the installation of grass-flower buffer strips along watercourses to enhance biodiversity and reduce runoff and erosion. On a very fine scale, these measures have already resulted in an increase in pollinator activity and a reduction in run-off.



Photos: grass-flower buffer strips (Province of East Flanders; left and middle) and flowers with insects (Ghent University; right).

The implementation of these measures has been made possible through the active involvement and engagement of local farmers. Participation is voluntary and operates on a three-year basis. Farmers enter an official contract, supported by a financial agreement, to compensate for potential yield losses resulting from the installation of buffer strips.

To sustain farmer engagement, general informational sessions, as well as direct, personalized interactions, are regularly conducted. Demonstrations are provided, and the added benefits of implementing NbS are clearly communicated. Long-term cooperation with and among local farmers is expected to facilitate the scaling of these measures across the broader region.

Despite some challenges—such as weather conditions affecting buffer strip quality and occasional reluctance from farmers to establish or maintain them—there has been generally positive response to the restoration efforts. To date, over 15 farmers have entered agreements within the project framework, resulting in the implementation of more than 3 hectares of buffer strips. Interest in NbS adoption among farmers continues to grow.

5.2 Action 2: Increasing public support

Description of the action

Society as a whole and local communities on a regional scale are affected by the functioning of the freshwater ecosystems. While some ongoing initiatives, such as the Farm to Fork strategy (EC, 2020), highlight the need for EU food policies to increase consumer awareness, the general public is inadequately aware neither of the loss and degradation of freshwater ecosystems and natural resources at large due to conventional high input agriculture, nor of the challenges farmers are going through (Boogaard et al., 2011; Keesstra et al., 2018).

Strategic Action 2 aims at **enhancing society's awareness of the importance of healthy (freshwater) ecosystems and to generate support for NbS implementation and maintenance.** Increased societal awareness can lead to increased support for restoration actions through NbS. It requires improving the knowledge and increasing awareness of society of environmental degradation related to high input agriculture, the challenges encountered by farmers and the opportunity of increasing resilience





to environmental crises, including climate change through NbS. The specific actions on this point are the following:

- → Provide **evidence and information materials** for the public on environmental processes, such as the water cycle, and on the state of natural resources, in particular of soils.
- → Provide evidence and information materials for the public on the role of different land users and management practices in driving environmental degradation, and the challenges faced by these land users.
- → Showcase relevant **examples on how NbS and farming are interrelated**;
- → Enhance support for communities and regions to engage in public multi-actor discussion and engagement processes.
- → Enhance support of citizen science and farmers-led projects that focus on identifying success aspects for freshwater restoration and NbS.
- → Introduce a certificate on NbS as an add-on module (e.g. <u>the Global GAP spring add-on</u>) to existing certificates or as a stand-alone certificate, so that consumers could make informed choices (See Chen et al., 2024).
- → Assist mainstreaming a healthy and sustainable diet that requires less cultivated areas. This requires acting on consumer preferences (e.g. advertisement, education) and facilitating clear and engaging product segmentation (e.g. NbS certification, reinforcing organic labelling).

Roles and responsibilities

Target groups (letters refer to the ones listed in Section 1.3):

G - The general public has to get informed through the actions described above.

H - European, national and local civil organisations, especially those active in agriculture, environmental protection or nature conservation play an important role in providing information to and exchanging with the public.

I - Institutions and individuals of relevant sciences could support robust and evidence-based citizen science initiatives and farmers-led research. Linked to science, the education sector could also play a role in outreaching efforts of knowledge on the importance of the freshwater ecosystems, its relevance to agriculture, and on the importance of NbS, in their curricula. Concerning the tasks, the education sector could cover, it may be useful to submit a proposal to DG EAC to launch a related support program, covering the above-described aspects, for the education sector. Also, a cross-sectoral program by DG AEC and DG Agri on this aspect may be considered.

K - The Private sector can contribute to a more informed public, by increased information on the products consumers buy. In times that sustainability is at the heart of the consumers, it would help if companies picked up on the consumer interests in their promotion campaigns etc. However, it must be recognised that the private sector always follows the consumers' buying interest. Therefore, by more informed citizens, through the above-described actions consumers become more informed, which the private sector can then pick up on.

Timing of the action

This action should start as early as possible in the first phase between 2025 and 2030 and continue into the long-term (up to 2050 and beyond). An informed and supporting public is the basis for all other actions. Besides the starting phase, actions have to take place continuously.

Differences between Member States or regions to consider

While no major differences in this action would have to be made across Member States or regions, national differences may be needed to communicate in the most efficient and impactful way messages to the public. Additionally, countries and regions face specific differences in relation to freshwater challenges, which would require tailoring the messages to the specific problems on the regional and/or local scales. As an example, in some regions, risks of rising river (and sea) levels may





be a big public fear and regional risk, while in other regions drought and lack of water might rather concern the public.

Monitoring the effects of the action

If this action is performed successfully the following will be the situation:

- → The general public is informed about their regional freshwater ecosystem, they understand the importance of water management and related actions, as well as the main challenges farmers face. Exchanges on local and regional natural resources take place in various communities and regions in public multi-actor exchange formats, and possible alternatives are discussed.
- → A majority of the public supports restoration through the implementation of NbS by farmers. Viable financial means are present to support NbS activities through Action 2 as well as the labelling of their products and consumers deliberate decisions for water-positive products.
- → Schools actively participate in this information exchange in various age groups and play a role in supporting NbS actions on the farms in the local community.

Summary of action

This action is about amplifying the existing societal knowledge about struggles of farmers, the impacts of (intensive) agricultural practices in freshwater ecosystems, among others, and about alternatives to business-as-usual practices. It is hypothesised here that increased societal knowledge will lead to increased support of society to implement NbS on agricultural lands. To ensure that the knowledge is widespread, education should be extended to new actors who do not have adequate knowledge of this NbS.

5.3 Action 3: Improving policy and regulatory framework

Description of the action

Europe has developed numerous policies trying to address the pressures arising from intensive agriculture (EEA, 2020). However, this framework has so far failed to address these pressures, while simultaneously increasing the regulatory burden and not providing solutions to the economic and financial challenges faced by many European farmers. With 307 billion EUR of planned total public expenditure between 2023-2027, the Common Agricultural Policy is arguably the most influential European policy on agriculture, being a key source of funding for farmers and setting pan-EU standards for land management. Despite successive reforms to 'green' the Common Agricultural Policy since the 1990s, efforts have failed to initiate a large-scale transformation of the agriculture Sector towards more sustainable and resilient production systems that secures farm income while protecting freshwater ecosystems (EEA, 2020; Box 7).

Action 3 therefore **sets out priorities for reforming the current European policy framework to mainstream and upscale NbS in agriculture.** The intention is to propose actions that work for nature, farmers and the public. While acknowledging that agriculture is also influenced by many policies, such as trade agreements, regulations around food production, animal welfare and other climate and environmental policies, the focus in this section is on the integration of NbS in the current and future CAP. The CAP represents a significant part of the EU budget and plays a key role in leveraging the uptake of NbS in rural landscapes. Specific actions for improved implementation in the **current period** include:

→ Increase the coherence and ambitions in the application of <u>conditionality</u>. For an effective impact of the Good Agricultural and Environmental Conditions (GAEC) 2 (protect wetlands and peatlands), Member States should deliver comprehensive maps of wetlands and peatlands within their national boundaries and adopt strict protection requirements (e.g. no drainage, ploughing or conversion of wetlands, strict restrictions on ploughing and machinery use on peatlands). GAEC 4 (buffer strips along watercourses) could be made stricter by preventing ploughing or tilling of buffer strips along watercourses, while the recent





weakening of GAEC 7 (crop rotation) and 8 (protecting of landscape features) should be reversed;

- → Increase commitments towards interventions that reverse agricultural drainage, cut back embankments to allow flooding, adapt crop and arable operations, and restore, or create new artificial, wetlands. This should be enabled in a mix of voluntary measures combining ecoschemes, environmental and climate incentives and investments, as well as knowledge and advisory support;
- → Increase the use of CAP cooperation interventions (e.g. LEADER⁴, European Innovation Partnership (EIP)⁵) for implementing freshwater NbS across waterscapes (whole floodplains, catchments) to optimise their effect on freshwater ecosystems;
- → Enhance synergies of CAP with other European funds, such as LIFE, Cohesion Policies and Regional Funds, as well as national funds for river basin and flood management planning under WFD and the Floods Directive, and other water and nature protection policies (e.g. Nature Directive, Nitrates Directive, Nature Restoration Law). Major opportunities lie in joint projects between farmers, land managers and municipalities – more closely linking rural and urban areas for the benefits of restoration to trickle down whole catchments and river basins, as underpinned by the Commission's Long Term Vision for Rural Areas⁶ and the Rural Pact⁷.

Box 7.: Potential of CAP

The latest CAP programme 2023-2027 has established a new 'Green Architecture' that offers a number of obligatory and voluntary interventions that can contribute to support the implementation of freshwater NBS. Conditionalities in particular are an important lever to implement freshwater NbS as they are attached to payments reaching 89% of the EU's Utilized Agricultural Area (UAA) (EC, 2023). Most important conditionalities are those linked to protecting buffer strips along watercourses (GAEC 4), wetland and peatlands (GAEC 2) and landscape features such as small ponds, field margins and hedgerows (GAEC 8). Several requirements also aim to improve soil health in arable areas. This can protect freshwaters by restoring a natural flow across the landscape.

Other CAP interventions such as eco-schemes have the potential to shape the land management practice of many farmers by requiring more nature or climate positive actions. These are complemented by targeted funded environmental and climate or Investment interventions, which are elective and/or competitive. An examination of MS choices in designing their CAP Strategic Plans (CSP; Rouillard et al., forthcoming) reveals that CSPs most frequently support measures aimed at improving soil health, followed by initiatives to protect riparian zones through buffer strips along watercourses, and more broadly, those safeguarding grasslands from ploughing. MS have not used all the opportunities offered by the CAP 2023-2027 to support large scale restoration of wetlands and peatlands and other landscape features beneficial for freshwater ecosystems and the climate. There is a general lack of attention to addressing the impacts of flood management and drainage. Some MS may even subsidise further drainage. Substantial efforts are still needed to drive broader and more transformative change.

The large majority of CAP funding remains directed towards income support that can maintain perverse incentives for actions that damage freshwater ecosystems rather than promoting sustainable, long-term environmental measures. Funding should thus be re-directed towards interventions that recognise and value the role of farmers and land managers as providers of not only food products but also the many other public goods and services provided by healthy,



⁴ For more information on the LEADER programme: https://ec.europa.eu/enrd/leader-clld_en.html

⁵ For more information on the EIP: https://research-and-innovation.ec.europa.eu/strategy/past-research-and-innovation-policygoals/open-innovation-resources/european-innovation-partnerships-eips_en

⁶ https://ec.europa.eu/commission/presscorner/detail/en/ip_21_3162

⁷ https://ruralpact.rural-vision.europa.eu/rural-pact_en



biodiverse and resilient agroecosystems. Specific actions to increase the implementation of freshwater NbS, and beyond the more immediate changes that can occur include for any **future** CAP:

- → Tighten public funded payments to the provision of ecosystem services and better reward efforts that go beyond minimum standards;
- → Strengthen conditionalities to better protect wetland, peatlands, buffer strips along watercourses, and landscape features. More widely, support large scale uptake of more sustainable crop rotation, soil cover crop and tillage practices to enhance soil health and improved landscape-wide natural hydrology;
- → Adopt longer term and more targeted support schemes combining investment in the (re)creation and management of non-productive features such as wetland and landscape features, and area payments, bringing security of funding for farmers for the transition of their farm practices and higher benefits for the environment;
- → Increase support to sustainable investments, training, and environmental services to help farmers embrace alternative farming, such as regenerative farming, that delivers catchment-or landscape-level services;
- → Ensure productive investments that could otherwise impact freshwater environments abide by ambitious environmental performance standards, in order to avoid unsustainable use of water. Particular care should be given to drainage schemes and operations, the expansion of irrigation and the building of reservoirs in already intensively irrigated landscapes.

Roles and responsibilities

Target groups (letters refer to the ones listed in Section 1.3):

A - Farmers should seek to apply to available funding under the CAP to implement freshwater NbS that also increases their resilience to climate change impacts and helps them diversify their revenue streams. Preferably groups of farmers apply for cooperative and innovation interventions to implement catchment-wide interventions to have the greatest impact on water resilience.

B, **C** - Farmers representatives, advisors and advisory services embrace and actively support a transformation of the CAP to support farmers to become more sustainable and resilient. CAP should be seen as an enabler for the uptake of freshwater NbS that protect farmers from climate, social and economic shocks.

D, **E** - The Common Agricultural Policy is the key policy instrument. Its design for the programming period beyond 2027 by DG AGRI and national governments will be key to mainstream freshwater NbS. The Commission plays a crucial role in operationalizing the link between the CAP, the WFD, and the new Nature Restoration Law. It is tasked with steering current implementation efforts and ensuring that future programming periods have stricter environmental requirements and offer more green investment opportunities.

E - As some conditionality requirements are still to be fully designed (e.g. GAEC 2) and others are being revised (in particular GAEC 7 and GAEC 8), national governments have a current responsibility for avoiding rolling back on environmental commitments and in designing ambitious requirements that work for farmers and nature. Furthermore, national agricultural authorities have a role in maximising the use of existing interventions, such as eco-schemes, environmental and climate interventions, cooperation interventions, knowledge and advisory interventions to support ongoing implementation of freshwater NbS.

D, **E** - Other European institutions (e.g. DG REGIO) are key to ensure that action in agriculture is better integrated in a whole rural development approach in the future.

I - Institutions and individuals of relevant sciences can evaluate existing CAP support schemes and propose reforms that support the upscaling of NbS while reinforcing the economic viability and performances of farms.





Differences between Member States or regions

European agriculture is a very diverse sector, comprising a multitude of farming systems embedded in both contrasting and heterogenous geographies and socio-political settings. Therefore, a one-sizefits all policy approach cannot work if it seeks to impose solutions. MS have increasing flexibility in defining the details and thus implementation of the CAP measures, but this flexibility of implementation should not be allowed to override or avoid the delivery of agreed objectives.

Monitoring effects of the action

- → CAP Strategic Plans are implemented with increased attention to freshwater NbS.
- → Future CAP arrangements fully include the objective of restoring freshwater ecosystems in agricultural landscapes, including regarding the natural flow and morphology of rivers and water bodies.
- → Future CAP has improved their monitoring framework to better track implementation of freshwater NBS and their effectiveness.

Summary of action

In the short term (starting in 2025), the action calls for improving the design of specific interventions whenever possible (e.g. GAEC 2, 8) and actively supporting the uptake of freshwater, wetland and peatland restoration interventions through eco-schemes, environmental and climate interventions, and investment intervention, including through cooperation interventions to have maximum impact. In the medium term (2027), the action calls for a major disruption of the status quo, profoundly reforming the CAP to mainstream NBS in agriculture. Opportunities exist, as the textbox below illustrates with the recent choices in the UK with regards to their post-CAP agricultural policies (Box 8.).

Box 8: Current agricultural reforms in the United Kingdom

Since leaving the EU, the UK no longer follows the CAP, giving it the opportunity to develop its own agricultural policies. This is taking shape as a shift away from direct payments to farmers to payments tied to the delivery of public goods (ecosystem services). This shift presents a balancing act between transforming the agricultural system and managing a smooth transition away from the CAP. In England for instance, the 'Environment Land Management Programme' is set to replace direct payments by 2027, promoting sustainable land management, prioritizing local habitats and species, and supporting long-term, large-scale interventions. New regulations from 2024 include measures to prevent soil erosion and water pollution, with added support for restoring water bodies and peatlands. Similarly, Wales is phasing out direct payments between 2005-29 and will establish a 'Sustainable Farming Scheme' that includes support for mandatory and voluntary individual and collaborative actions. It includes mandatory wetland management, with additional optional and collaborative actions for water conservation.





5.4 Action 4: Initiate landscape partnerships for multi-stakeholders coordinated NbS implementation.

Description of the action

Cooperation between stakeholders at the landscape level are essential to achieve the needed transformation. Strategic Action 4 facilitates the **cooperation of land users in the catchment area or in a landscape** by **setting up a partnership between stakeholders and setting up a network of local NbS coordinators** (see Box 9 for an example of collaboration among stakeholders.). By engaging the farmers, this action emphasises the need to incorporate diverse perspectives, enhance collaboration and even strengthen the legitimacy and enhance the environmental, social and economic sustainability of the interventions. These partnerships would support and benefit from public participation (action 2) and would contribute to building a sense of ownership that helps all stakeholders understand challenges and exchange on possible solutions. Partnerships can derive several benefits from local CoP, including increasing expertise, improved restoration, communication of benefits and building networks (Kitamura et al., 2018). Suggested specific actions include:

- → Facilitate engagement between different types of farmers, and other land users within catchments to exchange on alternative farming practices and/or use of parts of catchments;
- → Increase stakeholder involvement in decision making regarding possible restoration of freshwater systems and related land use options.
- → Identify and address **potential trade-offs** between stakeholders, resulting from large-scale restoration;
- → Engage municipalities to cooperate with the agriculture Sector in applying freshwater NbS as the main land users after farmers, involving them in their design, implementation and monitoring.

Box 9.: A possible type of organisation that can help to foster local collaboration, Case study 17 Forth Catchment

Forth Rivers Trust (FRT) is a registered charity in central Scotland dedicated to protecting and maintaining freshwater environments across the Firth of Forth catchment, covering over 3,000km². FRT's vision for 2045 is that the rivers and wildlife of the Forth will be healthy and vibrant, naturally functioning, free from barriers and pollution, and home to a diverse range of native species, benefiting the environment and local communities.

A key element of FRT work relates to stakeholder engagement, fostering positive relationships between stakeholders and the environment to facilitate restoration at the landscape scale. The FRT achieves this by integrating restoration with agricultural business models, building new skills and capacity, and securing long-term maintenance through agri-environmental funding. The Trust is a successful multidisciplinary organisation that plans, manages, and delivers projects like weir removal, in-river restoration, and peat bog restoration to enhance biodiversity, carbon sequestration, and flood management. Its experienced team secures and combines funding from various sources to maximize restoration impact. For example, on the Allan Water (MERLIN Case Study 17), FRT coordinates the Allan Water Project Steering Group, engaging conservation charities, local authorities, public sector representatives, and others to collaborate on restoration efforts within the catchment.

As a charity, Forth Rivers Trust can commit to long-term projects, providing a holistic approach to restoration, including areas deemed "low value" for agriculture but "high value" for nature. FRT hosts site visits to showcase exemplary projects, shares knowledge, and engage local communities, enhancing restoration efforts and fostering citizen science initiatives, especially where long-term monitoring funding is lacking.







Roles and responsibilities

Responsibility for undertaking this action lies with farmers and their representatives, appropriate Member States environmental agencies, municipalities, catchment working groups, landowners and farmers.

Target groups (letters refer to the ones listed in Section 1.3):

A and B - Farmers and their representatives constitute a core component of partnerships that rely on the participation of local and active stakeholders. They communicate their interests and concerns. Champions can help share and maintain good practice examples.

D - European-level commission services (financially) assist bottom-up civil, local development organisations in the framework of rural development (e.g. through the CLLD (Community-led-local development) funding approach developed by DG AGRI and translated to DG REGIO), prepare best practice guidelines for NbS implementation in agricultural lands and highlight their associated social, economic and environmental benefits, and help identify and discuss trade-offs with other stakeholders at the regional, national and European levels.

E - Ministries and authorities at Member State level (esp. Managing Authorities and Paying Agencies) related to EARDF and Cohesion Funds.

F - Municipalities and their interest representation bodies can develop plans and guidelines for large-scale restoration, bring local stakeholders together through meetings and other engagement platforms, motivate stakeholders to understand large-scale restoration programmes with involvement of communities, and identify and discuss trade-offs among local stakeholders.

H - European, national and local civil society organisations, esp. those active in local development, environment protection or nature conservation, can connect different stakeholders, and bring knowledge and experience on implementation of NbS and, where needed, technical assistance. Local organisations may also facilitate dialogue and engage local stakeholders by leveraging the trust they may have established with these groups.

Differences between Member States or regions

No major differences are expected, although some Member States already have some sort of collective approaches to agricultural practices (e.g. collectives in the Netherlands) that partnerships could build upon. For instance, the Netherlands uses a collective model of governance around agrienvironmental measures to coordinate conservation measures at a landscape scale. Collectives, i.e., groups of farmers, are the only entity that is allowed to receive subsidies for farmland habitat conservation. The Netherlands' collective model for agri-environmental measures is an example of coordinated governance in agriculture. By requiring farmers to work together in collectives to access subsidies for farmland habitat conservation, the system encourages collaborative decision-making and aligns individual efforts toward broader landscape-scale environmental goals. This approach not only ensures more cohesive conservation practices but also simplifies administrative processes, as collectives, rather than individual farmers, are the point of contact for subsidy distribution.

Monitoring effects of the action

- → Catchments where there is agricultural activity establish partnerships/working groups to coordinate restoration activities on a landscape basis.
- → Local partnerships/working groups, with the involvement of the agriculture sector, are recognised by MS for their role in mainstreaming restoration on a catchment basis.
- → Opportunities for land users at the catchment level to get involved in decisions regarding large-scale NbS for agricultural areas.
- → Trade-offs from large-scale restoration clearly identified and discussed stakeholders.
- → Farmers have a voice in these settings and a community spirit is developed in realising a positive water ecosystem together.





Timing of the action

The proposed action to create and enhance landscape partnerships should begin immediately in 2025 to establish the foundations for long-term collaboration (beyond 2050). The effort will continue through 2050, evolving over time to strengthen short-term and medium-term goals. The process requires careful coordination and engagement of stakeholders across different spatial scales and levels of governance, which may take time to organize effectively.

Summary of action

This action involves the creation of new landscape partnerships to address challenges in sustainable land management. Even for regions with existing collective frameworks, this action can be seen as disruptive as it brings together stakeholders with different stakes and interests, and potentially introduces new methods or governance structures. Success will depend on early initiation, adequate resource mobilization, and a strong commitment to collaboration over decades.

5.5 Action 5: Accelerating relevant innovation

Description of the action

Transitioning to sustainable agriculture that incorporates NbS while maintaining productivity requires advanced technological innovations, such as new genomic techniques (Niggli, 2024) and precision agriculture (Abbate et al., 2022) offer significant potential to complement NbS (Giagnocavo et al., 2022). Strategic Action 5 aims at supporting the prioritisation of **new agricultural production systems, products, technologies and related services** solving the conflicts between NbS and bioeconomy. Societal innovations, including shifts in purchasing behaviors and consumption patterns, and diet shifts are critical to achieving sustainable development (Clark and Tilman, 2017; Niggli, 2024). Specific actions include:

- → Disseminate to farmers, the general public, and policy makers, the existence and the importance of innovative production methods (e.g. linked to precision agriculture, agrivoltaics, and smart (irrigation) techniques) as base for the green transition of agriculture.
- → Demonstrate **evidence of socio-economic and environmental benefits** of agricultural innovations for farmers and for consumers.
- → Elaborate proposals to relevant DGs to create more efficient mechanisms in relevant policies to enhance innovation on topics which would help mainstreaming restoration of freshwater ecosystems. Such topics include:
 - → improving methods to measure and monitor ecological benefits when restoring aquatic ecosystems and soils (e.g. soil biodiversity edaphon).
 - → finding and elaborating better and cheaper bio-indication (edaphon) methods for measuring soil health.

Integrating technical innovations with NbS will support the transformation of the agriculture sector towards sustainable practices that contribute to (freshwater) ecosystem restoration while maintaining productivity (Giagnocavo et al., 2022; Abate et al., 2023). They might also enable the production of food on partially flooded floodplains.

- → Raising Awareness: Disseminating knowledge about innovative production methods, such as precision agriculture, agrivoltaics, and smart (irrigation) practices, to farmers, policymakers, and the public, highlighting their role in the green transition of agriculture.
- → Demonstrating Benefits: Providing clear evidence of the socio-economic and environmental advantages of agricultural innovations for both farmers and consumers.
- → Policy Proposals: Developing proposals for relevant European Commission Directorates-General to enhance policy mechanisms that foster innovation. These proposals should focus on:
 - → Improving methods to measure and monitor ecological benefits from the restoration of aquatic ecosystems and soils, including indicators like soil biodiversity (edaphon).





- → Developing cost-effective bio-indication methods for assessing soil health using edaphon.
- → Reinforcing and mainstreaming agricultural insurance and ensuring that it covers new ways of farming.

Achieving high agricultural productivity with minimal environmental impact is essential, particularly in less efficient systems. Advanced technologies and management techniques can increase input efficiency (Clark and Tilman, 2017), while reducing negative environmental externalities (Abbate et al., 2023). By integrating technical innovations such as precision agriculture with NbS, sustainable food production systems can be achieved. These systems reduce input reliance, replace agrochemicals with ecological principles (Duff et al., 2022; Giagnocavo et al., 2022). Ultimately, combining technological advancements with NbS will drive the agricultural sector's transformation toward sustainable practices, contributing to the restoration of freshwater ecosystems while safeguarding productivity (Giagnocavo et al., 2022; Abbate et al., 2023).

Accelerating technological innovations in agriculture to lower the environmental impact of the Sector has received increased attention in science with recent projects being funded on this topic, such as some projects falling under the "EU Mission 'A Soil Deal for Europe', 2023' or the <u>REACT4MED</u> <u>Project</u>, funded by PRIMA, a Programme supported by Horizon 2020.

Roles and responsibilities

Target groups (letters refer to the ones listed in Section 1.3):

C - Agricultural advisors can support the dissemination of knowledge about technical innovations, guide farmers in adopting innovative techniques, and identify bottlenecks in the implementation and contribute to solutions. They can also help farmers access available funding, tools, and training opportunities, ensuring the practical application on the ground.

D - European Institutions Commission services coordinating relevant development programmes. They can drive innovation by funding pilot projects, research initiatives, and knowledge-sharing platforms while fostering cross-border collaboration to exchange best practices and strengthen agricultural innovation networks. By prioritizing research and development efforts, they support the development and application of new technologies, methods, and scientific insights for sustainable agriculture. Such European Services include:

- → Primarily DG AGRI, which operates agricultural innovation programmes;
- \rightarrow DG Research & Innovation, which is responsible for boosting R&D activities;
- \rightarrow DG REGIO which assists relevant climate actions in urban areas;
- → Just Transition Fund and DG CLIMA can support the use of farming techniques linked to bioenergy, both by providing guidelines and ensuring financial assistance.
- → finances development projects of municipalities above 5000 inhabitants (mostly cities) and experimented Community-Led Local Development (CLLD) tools for cities;
- → DG ENV which finances larger projects in sustainable natural resource management;

E - Ministries (Managing Authorities) and Paying Agencies relevant to agricultural and research policy at Member State levels. National ministries and agencies can integrate innovative practices into agricultural and research policies by aligning funding mechanisms and regulatory frameworks. They can provide grants and subsidies for farmers and researchers working on projects relying on innovative practices while ensuring alignment with EU policies. Additionally, they can streamline administrative processes to make funds more accessible to stakeholders.

I - Institutions and individuals of relevant sciences can collaborate with farmers to co-develop and test innovative (NbS) practices. They can generate evidence on the benefits of NbS for both productivity and ecosystem health. Institutions can also host knowledge-sharing activities and train future agricultural professionals in innovative farming practices, to facilitate their adoption.

J - Private companies sourcing agricultural products can play a key role in accelerating innovation in the agricultural Sector by investing in research and development, fostering





partnerships with farmers and other key stakeholders, offering incentives, technical support, and financial resources to farmers, and creating or expanding markets for innovative products.

K - Agricultural insurance companies can reduce risks related to innovations, creating incentives for farmers to use new or alternative ways of farming.

Timing of the action

The dissemination should start now (2025) but should get more amplitude in the medium-term (2030).

Differences between Member States or regions to consider

Innovations should be selected by farmers to best match their skills and the geographical context in which they implement them. This means ensuring alignment with the unique characteristics of the local environment, as well as the needs of local and regional markets, while also providing a favorable cost-benefit ratio.

Monitoring the effects of the action

- \rightarrow Improved acceptance of innovation by farmers and consumers;
- \rightarrow Increased uptake of innovation by farmers;
- \rightarrow Growth of markets for innovative products.

Summary of action

Innovations are already being adopted by farmers. However, current barriers, such as financial constraints and risk avoidance behaviour, limit the uptake of such innovations (Long et al., 2015). While socio-economic innovations, particularly in areas like direct marketing, farmer cooperatives, generally receive strong societal support (Niggi, 2024), some technological innovations may encounter public resistance (Siegrist and Hartmann, 2020).

5.6 Action 6: Getting the market support for NbS implementation in agriculture

Description of the action

NbS approaches implemented at farm level or by groups of farmers at larger scales will deliver both **private goods** and **public services**, that require **new value chains and market mechanisms** to reward the efforts done by farmers in implementing NbS and working with nature, and the resulting ecosystem services (Morri and Santolini, 2022). While public support and subsidies play a great role in this sense, the private sector can go beyond and ahead of this public support by improving their own operations, speeding up the process of transformation, making additional resources available and sharing the effort of increasing the resilience of landscapes. New products, certifications, payments for ecosystem services, premiums from retailers or industry, among others, will allow farmers to compensate for both additional and opportunity costs. They will ease access to any eventual financing needed for implementing NbS or transforming their practices.

The current legal framework for sustainability and nature disclosure for private companies in Europe (CSRD - Corporate Sustainability Reporting Directive- and CSDDD - Corporate Sustainability Due Diligence Directive) requires companies to disclose their impacts and, either directly or indirectly through consumer pressure, to act to reduce them. Reporting and response extend to their value chains, therefore opening great space for collaboration with the agriculture sector in reducing impact and increasing resilience through NbS implementation. Still, those directives do not apply to all companies, only to the larger ones, while most companies are exposed to the risks derived from climate change, biodiversity loss and unsustainable practices, and should therefore identify the benefit of going beyond legal requirements to help transform the sector, upscale NbS and reduce their own risks.





One of the important aspects in establishing new value chains to support NbS implementation, is creating win-win situations for the involved chain actors. This was clearly seen in the value chain case analysed for this sector within MERLIN (Chen et al., 2024), in Mangfall, where farmers agreed to move to organic farming practices because they saw the benefits for their region and for themselves, and received support for their transformation. A commercial opportunity for local organic milk was derived from this initiative, as is explained in Box 10.

Collaborative approaches are relevant when strengthening a whole value-chain approach (Grashuis and Su, 2019), facilitating uptake of freshwater NbS through better market conditions. This is particularly key for farming systems transitioning from specialised to mixed farming systems (Meynard et al., 2018).

Box 10.: Creating new value chains, Mangfall case study. From Chen et al., 2024.

Since the 60's the water supply of the city of Munich has been threatened by nitrates coming from surrounding farming land. In the 90's pesticides were also reaching the drinking waters, posing a critical problem for Stadtwerke München (SWM), the local water company.

80% of the water was coming from Mangfall river, an intensive agriculture area, specially of cattle farming. Through the close cooperation between SWM, eco-associations such as Naturland, Bioland, and Demeter, the farmers' association, and the municipal estates of the state capital, a new initiative aimed to convert over 6,000 hectares of land located in selected drinking water protection areas to organic farming. Starting with a start-up financing program in 1992, this program provided financial compensation to farmers to ease the initial burden of transitioning to organic farming, and payment from SWM was extended to maintain the practices. Farmers in the program continued to receive EU agricultural funding.

The project expanded beyond its initial area to include the Munich gravel plain, increasing the conversion area to approximately 9,000 hectares. The transition to organic farming has significantly and sustainably reduced the nitrate levels in Munich's drinking water. In addition, it has also paved the way for the creation of local organic dairy products. Collaborations emerged with upstream value chain partners such as the dairy farm Berchtesgadener Land Molkerei (BGL) who created the 'Unser Land' ('our land') milk brand. All milk for the 'Unser Land' brand is sourced from the Mangfalltal area, and the products proudly display the project's details on their cartons and website, informing consumers about the sustainable practices behind their milk and highlighting their role in protecting drinking water sources.

Strategic Action 6 promotes the improvement of the position of farmers in the agri-food value chains and increased resources for the investments and capacity-building needed for the transition to sustainable farming systems, at the Sectoral level. The CAP includes a specific intervention type, i.e. sector interventions, but it is currently not used to support a coherent and ambitious implementation of sustainable farm practices and sector-wise transitioning. Additional resources could also be mobilised to design and mainstream business models that exploit the ecosystem services provided by freshwater NbS in agroecosystems (e.g. carbon mitigation, flood risk reduction, biodiversity offsetting, agri-tourism, etc). Suggested actions include:

- → Test and establish innovative financing mechanisms, such as Payment for Ecosystem Services Schemes (PES), to reward farmers for the ecosystem services they provide through the implementation of NbS. The success of these mechanisms depends on their specific context and relies largely on national financing and an appropriate legal framework (Montoya-Zumaeta et al., 2021), thus they need to be designed and tested for specific cases.
- → Explore **new products, alternative ways of farming and diversify activities**, including:
 - → additional profit from land removed from production for the implementation of NbS (e.g. flowers, as is being searched in MERLIN case 11. Emscher, biomass under sustainability criteria, honey, seeds...);
 - → nature tourism opportunities;





- ightarrow change to organic farming (as in Mangfall example; see Box 10 and Chen et al., 2024);
- → alternative more climate-resilient crops;

The creation of new value chains or products with additional value, can **turn Nature-based Solutions projects into "bankable"**, especially if investors are involved in the design early in the process. Nature Bankable projects are those that have the ability to create positive environmental returns that lead to improved biodiversity and climate mitigation and/or adaptation, while also being attractive for financial institutions to invest in (WWF and Nature^Squared, 2020), as they create revenues that can be captured and returned to an investor. Making NbS bankable can attract additional private funding for their implementation.

- → Explore whether introducing an NbS certification/labelling system, as an add-on module to existing certifications (such as <u>Global GAP</u>, <u>Organic farming</u> or <u>Alliance for Water</u> <u>Stewardship</u>), or stand-alone label, is viable. <u>IUCN Global Standard for NbS</u> could be used as a starting point, to be adapted to the specifics of the sector. The use of such certification would allow for consumers to choose such products and the farmers to be acknowledged for adopting NbS.
- → Exchange on successful examples of collaborations and new financing mechanisms between market players, public service providers and especially farmers, by all stakeholders along the value-chain and disseminate these examples to the general public.
- → EU institutions and MS should recommend entities subject to CSRD and CSDDD to set targets for nature with a scientific base, for example validated by the <u>Science Based Targets</u> <u>Network</u> (SBTN-validated), to expand the focus from the current one, limited to climate mitigation. SBTN is a civil-society and science-led initiative that helps companies and cities set targets using best available science, defining "what is necessary to do their part to stay within Earth's limits and account for people's needs".

Roles and responsibilities

Target groups (letters refer to the ones listed in Section 1.3):

A - Farmers are key to establishing any new market mechanisms, they shall be willing to implement NbS interventions, help in their design and monitoring of their impact, and be open to collaboration with other actors. These other actors, municipalities and private entities from the same or other sectors operating in an area, shall also be open to paying for the services provided by NbS implemented by farmers. Companies sourcing agriculture products from the area (retailers, food and beverage, textile, energy...), shall be ready to help cover the costs of capacity building and of the implementation of NbS, as well as contribute to testing pilots for the new mechanisms.

B - The appropriate legal framework to allow for these actions and transactions, needs to be implemented by EU and MS, and farmers unions and associations at national and European level should support the farmers' efforts by easing and advocating for the implementation of such enabling framework.

C- When it comes to improving certification schemes and labels to incorporate NbS criteria, there is a role for both private entities in charge of those labels, and for the EU Commission and entities participating in the definition of EU's Organic Farming label. Auditors, finally, should be properly trained to be able to check the new certification or labelling criteria.

H - Civil Society Organisations and NGOs can help in testing and piloting these new interventions, in collaboration with farmers, their new partners and their customers, and science.

J - Private companies sourcing agriculture products can support new value chains and market mechanisms (e.g. via Scope 3 emissions accounting).







K - Public and private financing institutions, including banks, investors and insurance companies, can support projects by helping to design and implement bankable projects including productive and non-productive investments in sustainable agriculture value chains.

Timing of the action

This action should start immediately (2025) but should be further mainstreamed and accelerated in the medium-term, by the beginning of the new EU budget (2028), when other actions 1, 2 will be more advanced and the implementation of NbS will be considered as the new business as usual.

Differences between Member States or regions

New market opportunities will vary depending on the context in which the NbS are implemented.

Monitoring the effects of the action

- → Innovative financing mechanisms, such as Payment for Ecosystem Services Schemes, are set up;
- → New farming products and services are developed. The finance sector is involved in the development of new products and services, resulting in bankable NbS projects in place.
- → Companies commit to help improve their supply chains by supporting implementation of NbS and ensure traceability of the NbS interventions implemented;
- → An add-on module on NbS is designed and is ready to be tested to be incorporated into existing certification frameworks;
- → Platforms to facilitate learning from successful examples of collaborations between market players, public service providers and especially farmers are set up;
- → Companies subject to CSRD and CSDDD regulations set science-based targets for nature.

Summary of action

The sector develops new products or services linked to NbS, broadening its activity involving other sectors. The establishment of *ad hoc* market mechanisms (e.g. certifications and/or payments for ecosystem services), rewards NbS in farming and attracts investors.





Strategic actions

5.7 Summary of actions

Table 1 and Fig. 6 summarise the strategic actions and their timeline, within a broader political and societal context.

Table 1: Summary of the strategic actions.

	What	Who	When
Action 1	Engaging and assisting land users to adopt NbSs in water retention Landowners, land users, authorities, need to be aware of the present status of aquatic ecosystems including soil health and the importance to restore them by applying NbS. They should also be informed about the methodology and pathways to implementing such measures.	 → Farmers and their representation bodies and organisations at EU and Member State levels. → Municipalities and their interest representation bodies. 	2025 and beyond
Action 2	Increasing public support It is essential to mobilise a critical mass in the public to enforce changes in related policies. As society is not adequately aware of the loss of natural resources related to agriculture and to the regulation of the surface waterflows, it is vital to motivate them to support restorations through applying NbS.	 → The general public, esp. young and active age population. → European, national and local civil organisations, esp. in environment protection or nature conservation. → Institutions and individuals of relevant sciences. → Private companies 	2025 and beyond
Action 3	Set out priorities for reforming the current European policy framework to integrate NbS in the current and future CAP.	 Farmers and their representation bodies and organisations at European level EU Ministries (DG Agri, DG Env, DG Regio, DG Research). European, national and local civil organisations, esp. in environment protection or nature conservation. Farmers; Farmers representatives, and advisors; European Commission services; Ministries and authorities at Member State levels; 	Immediate start (2025, current CAP) and 2027 (future CAP).

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		→ Institutions and individuals of relevant sciences.	
Action 4	Initiate landscape partnerships for multi-stakeholders coordinated NbS implementation to incorporate diverse perspectives, enhance collaboration and even strengthen the legitimacy and enhance the environmental, social and economic sustainability of the interventions.	 Farmers and their representatives; European-level commission services; Ministries and authorities at Member State level; Municipalities and their interest representation bodies; European, national and local civil society organisations. 	Immediate start (2025)
Action 5	Accelerating relevant innovation to support the prioritisation of new agricultural production systems, products, technologies and related services	 Agricultural advisors; European Institutions Commission services; Ministries and Paying Agencies relevant to agricultural and research policy at Member State levels; Institutions and individuals of relevant sciences; Private companies sourcing agricultural products. 	Immediate start (2025) but gains amplitude by 2030
Action 6	 Market + Financing → Farmers; → Farmers representation bodies and organisations at EU and Member State levels; → Food Industry and Retailers, related service sector; → Civil Society Organisations and NGOs; → Public and private financing institutions. 		Immediate start (2025) and grow midterm, with new EU budget (2028)







	2020		2030	204	10	2050
UN Sustainable Development Goals			\bigcirc			
European Climate Law			55%			Net Zero
European Green Deal		2020-30	2	25% organic, -20% fertilis	er, -50% pesticide i	risk
Nature Restoration Law						
Re	storing all	EU land and sea	20%			100%
Re	estoring de	graded habitats	30%	60	396	90%
Restoring organ	ic soils use	ed by agriculture	30%	40	996	50%
Biodiversity – increasing t	rend, to sa	atisfactory levels		•		
	Con	nmon Bird Index	4			
Common Agricultural Policy						
River/Flood Basin Management Plans	MP 2	RBMP 3	RBMP	4 RBMP 5	RBM P 6	
Water Smart Strategy		2024-29)			
MERLIN Actions						
Action 1 Engage and assist farmers to adopt NbS						
Action 2 Increasing public support						
Action 3 Improve policy and regulatory framework						
Action 4 Landscape partnerships to coordinate NbS						
Action 5 Accelerating relevant innovation						
Action 6 Market support for NbS			-(

Figure 6: Timeline of the strategic actions within the broader European political context.





6 Discussion

The Strategy positions the agriculture sector as a crucial ally in implementing and mainstreaming NbS for largescale freshwater restoration, addressing numerous societal challenges simultaneously. To achieve this, the Strategy highlights key actions that include engaging and assisting land users to adopt NbS, increasing public support, improving policy and regulatory framework, setting up knowledge sharing capacities, initiating landscape partnerships for multi-stakeholders coordinated restoration, accelerating relevant innovation, and strengthening market and financing market mechanisms.

These actions, developed through stakeholder and expert input, address barriers and leverage opportunities for integrating NbS into agri-food systems. These actions align with the barriers and opportunities commonly identified to support the implementation of NbS in agri-food systems. For instance, knowledge sharing and facilitating collaboration between several stakeholders have been identified as key actions to support the implementation of NbS in agricultural lands (Chappin et al., 2024). Policies and their enforcement, both at national and local levels, in alignment with European requirements, as well as innovative financing mechanisms are central to facilitating the implementation of NbS by farmers (Budding-Polo Ballinas et al., 2022, De los Casares and Ringel, 2023). In that respect, capturing all benefits that NbS could provide for farmers and society at large could help justify investments in NbS (Kok et al., submitted).

While progress is evident through ongoing sectoral and policy initiatives (Helfenstein et al., 2024), the agriculture sector's diversity presents challenges. Stakeholders display varying attitudes towards practice changes (Sok et al., 2024) and differ in their readiness and willingness for transformation (EEA, 2024). By addressing these challenges and leveraging identified opportunities, the Strategy provides a pathway for fair and sustainable transformation in the agriculture sector, ensuring alignment with societal goals and environmental imperatives.

6.1 Cross-sectoral implications

Undertaking large-scale restoration will also require balancing trade-offs between different sectors and wider economic, social and environmental needs (Gomez-Martin et al., 2020). Agriculture has connections with many sectors which are also dependent on the freshwater ecosystems. All other MERLIN sectors are linked with the practice of agriculture, i.e., the peat extraction, inland navigation, water supply and sanitation, hydropower and insurance sectors. Other sectors, outside of MERLIN's scope, are also critically connected to agriculture, such as tourism, bioenergy and forestry. However, they have not been considered here. While upscaling NbS on agricultural areas can benefit these sectors in different ways, their own constraints, conditions and actions may restrict the implementation and effectiveness of those NbS. Platform to engage stakeholders from these different sectors and facilitate dialogue between them, as well as governmental interventions as subsidies may help cross-sectoral collaboration in efficient implementation of NbS.

6.2 Progress on Mainstreaming

The agriculture sector is diverse, encompassing various stakeholders with differing attitudes towards changes in agricultural practices (Leitheiser et al., 2022; Sok et al., 2024). Protests across Europe reveal farmers' discontent (Calatrava et al., 2021; Di Bene et al., 2022), driven by perceived pressure on farm incomes, stricter environmental regulations, and increased trade competition (Matthews, 2024). Farmers feel the present pressure for greening their activities is unfair, when the impact of agricultural transformation on farmers' social and economic wellbeing are underrepresented in policy and science (Janker et al., 2018), and because entrenched "locked-in" situations hinder progress toward sustainable transitions (Williams et al., 2023). Yet, multiple ongoing initiatives exist within the sector, demonstrating the feasibility of incorporating nature restoration into agricultural practices (Helfenstein et al., 2024). Motivations and obstacles related to farmers' willingness to change their practices include their capacity to tolerate financial and other risks and their awareness of, and the credibility of, knowledge on alternative farming practices (Dessalegn et al., 2018; Chene et al., 2020).

The *Strategic Dialogue on the Future of EU Agriculture* (Box 11.; EC, 2024) reflects the perspectives of 29 major stakeholders from the European agri-food sectors, civil society, rural communities, and academia. This report







emphasises the urgent need for change in the Sector, stating that transformation must occur from "now." This urgency implies that the Sector is actively navigating change and calling for its institutionalisation (Fig. 5). The Dialogue calls for comprehensive measures from both the EU Commission and Member States to support transformation and sustain the competitiveness of a reformed agriculture sector. Such measures, implemented at both European and Member State levels, are intended to provide farmers with the essential support to facilitate change on the ground.

However, not all institutions are already on the pathway for transformation with regards to agriculture and restoration, urging for immediate actions, including a revision of the current policy framework. (EEA, 2024b). While challenges still exist, significant progress has already been made towards achieving this transformation. The strategy's implementation stages are outlined as follows:

- **1. Drivers for Implementation**: Key drivers of transformation are already active, as stakeholders across levels recognize the need for change in response to environmental and societal crises.
- 2. Preparation for Strategy Implementation: All stakeholders within the agriculture sector are encouraged to adopt this strategy and engage with relevant European and Member State authorities to facilitate its implementation. Collaborating with these authorities will help determine the required resources and establish implementation procedures.
- **3.** Navigating the Implementation Process: The six defined actions should be implemented by designated target groups, leading to the creation of a structured landscape.
- 4. Institutionalising the Strategy: This stage will proceed alongside stage 3, aiming to establish large-scale restoration as the norm, guided by the strategy. The landscape authority and necessary policy frameworks will need to be established.

Box 11.: Strategic Dialogue on the Future of EU Agriculture. Sources: EU COM website. <u>https://ec.europa.eu/commission/presscorner/detail/en/ip 24 4528</u>

Recommendations are addressed to the EU Commission and Member States, and structured in five pillars:

Working together for a sustainable, resilient and competitive future: this part addresses the need to adapt the CAP in the context of the ongoing transition towards more sustainable and competitive food systems, the importance of strengthening of farmers' position in the food value chain, access to finance, and the role of trade and international standards.

Advancing towards sustainable agri-food systems: the recommendations under this heading dive into the support and promotion of sustainable farming practices, including for livestock farming, and advocate for increased awareness about animal welfare and empowerment of consumers to choose sustainable and balanced diets.

Promoting transformative resilience: in the face of growing environmental, climate, geopolitical and economic risks, the report outlines the need to strengthen risk management tools and crisis management as well as to better preserve and manage farmland, promote water-resilient agriculture, and develop innovative plant breeding approaches.

Building an attractive and diverse sector: the importance of generational renewal and gender equality as well as vibrant rural areas and agri-food systems is detailed in this section, including the need to protect workers.

Better access to and use of knowledge and innovation: the recommendations conclude that access to knowledge and skills must be facilitated, and that digitalisation is an opportunity.

6.3 Challenges for mainstreaming the transformation actions

As presented in Section 4, Transformation may be usefully interpreted as three Action types (Create, Maintain and Disrupt) addressing three system Elements (Personal, Practical and Political). For the Agriculture Sector the key changes are summarised in Table 2 and elaborated below.





Table 2: Possible elements and actions to support the transformation of the Agriculture Sector

	Create (where gaps)	Maintain (build on)	Disrupt
Personal	New perspectives on the role and responsibility of land managers. Clear, verifiable statements of outcomes for participants and stakeholders See Action e.g. 5 (sub- actions 5.1 and 5.3)	Peer-to-peer learning networks – to create critical mass to be effective and change norms. See Action 5.4	Group think – challenge negative narratives, generate awareness and conceptual change.
Practical	New skills and technologies – career paths Funding for coordination and cooperation – above farm level.	Reward going beyond minimums. Inspect and advise on options for all farm businesses. Publish participation and outcomes (state of environment).	Break complexity barriers to undertaking NbS. Pay-back model of funding – need wealth to apply.
Political	Clear direction of travel and binding targets. State a preference for NbS over other solutions. Use NbS-friendly project evaluation rules – all costs and benefits considered, not just financial.	Increase conditionality for farm funding. Fund long term monitoring and evaluation of impact to show good practice examples.	Regulatory capture. No consequence environmental damage - enforce and enhance minimum standards.

Personal

At the personal level, it is necessary to generate awareness of the issues and the conceptual change in which the challenges of climate and biodiversity crisis are owned by landowners, and they agree on what should be done. This means challenging non-critical group-think and negative divisive narratives (often fostered by mass media) about responsibilities, and focusing on what can be done now. The new perspective on the roles and responsibilities of land managers can be generated in individual R&D projects and cases but there needs to be a concerted effort to use these within existing peer-to-peer learning networks. In these networks NbS entrepreneurs need to be supported to build critical mass locally and thus to start to change norms globally. There also needs to be clear and verifiable statements of the anticipated positive outcomes of restoration interventions that address the concerns highlighted in the negative narratives.

Practical

Individual personal change is not enough to allow the Sector to change. New practices and NbS implementation require new knowledge and skills that can be in short supply. Recognising the need for training and the potential for new rural career paths or on-farm diversification can address these shortages. Yet for NbS to be







effective there is often the additional need for between-farm cooperation which may require third party cooperation or coordination to facilitate or broker deals. Rewards beyond regulatory minimums can be a key to changing expectations of what is "good practice". Ideally this would be financially rewarding (e.g. via PES) but even recognition via making such commitments visible via publication may be effective especially where value chains are increasingly looking to highlight sustainability credentials and brand values.

Supporting good practice by a combination of inspection and advice has been shown to be far more cost effective in raising standards than enforcement alone (Faure et al., 2018; De Vito et al., 2020; Bérczi-Siket et al., 2022). The complexity of stakeholder participation on NbS, or funding schemes that imply upfront investment with uncertainty on the return, can deter participation but can be addressed by advice, process simplification and by investment in communications.

Political

While cultures and norms are often perceived as political phenomena, they may well be emergent properties of the interactions occurring at personal and practical scales. NbS political factors that would enhance outcomes for the agriculture sector include clear and consistent communication of the direction of travel - clear vision or goals - with binding and meaningful targets. By setting the framework of rules (formal and informal), the governance regime plays a key role in enhancing (or otherwise blocking) the use of NbS in the agriculture sector. In doing so, NbS should be stated as a preferred solution compared to other ("grey" infrastructure") solutions, and clear rules should be defined for evaluation methodology and procurement rules of NbS- friendly projects to calculate costs and benefits in a consistent manner. Building on the trend to increasing conditionality for farm payments, both large-scale and small-scale NbS should be included in mainstream agricultural practice with expectations gradually increasing over time. Key to the acceptability of such conditionality, and NbS more widely, is the need to generate verifiable statements of outcomes and here the commitment needed is to the long-term monitoring and evaluation of existing NbS projects to assess the efficacy and longevity of legacy. Key barriers to wider scale NbS in agriculture are the regulatory capture of agriculture by agri-food lobbyists that reinforce the negative narratives referred to earlier. Progress can also be undermined when minimum standards of environmental performance are not adhered to, both making the efforts of others less effective and encouraging free-riding.

6.4 Working with the CoP Practice for Transformation

Building a community of practice with the agriculture sector has proven a challenging task (Schulz et al., 2024). On one hand, many European projects aim to work with the Sector, which may lead to stakeholder fatigue. This is especially relevant when trying to approach agriculture related organisations operating Europe-wide and based in Brussels. The time frame (2021-24) also meant that there was reluctance from some agriculture sector representatives to be seen engaging with environmental restoration objectives while the Nature Restoration Law (European Commission, 2024) was being deliberated on. The post pandemic period also justifiably saw prioritisation of recovery and growth but regrettably in some cases this led to the promotion of productivist narratives that were (often needlessly) antagonistic to Green Deal ambitions. The opportunity to "build back better" or at least "greener" has not to date been realised. The decisions on how EU macro-policy for the 2024-29 Commission and Parliament will frame issues and expectations of the agriculture sector will set the direction of travel and expectations for the sector and the likelihood of more engagement with NbS.

Progress in mainstreaming freshwater restoration within the agriculture sector through adopting NbS will be seen as more legitimate where it is clearly adhering to the principles of Just Transformation as articulated in Schulz et al., (2024). Just Transformation aims to ensure that the need for change is coherently and clearly articulated, the change process is shaped through a fair representation, considers the values of relevant stakeholders and sees fair distributions of cost and benefits (i.e. burden sharing). There is also the need for equality of opportunity to be ensured, since issues such as access to financial capital can otherwise mean that NbS actions are options only for landowners (rather than tenants) or smaller than median size businesses such as family-farms. In the agriculture sector CoP process, efforts were made to ensure a fair representation of a wide range of stakeholders based on the engagement approach identified in Section 2.





7 Conclusions and next steps

This strategy has set out the background requirements for large-scale freshwater restoration through the implementation of NbS on agricultural lands. The Strategy emphasizes key areas such as regulatory, technical, political, financial, and governance mechanisms, alongside awareness raising, to achieve transformative changes across multiple scales. To guide this process, the strategy identifies six critical action points:

- \rightarrow engaging and assisting land users to adopt NbS,
- → increasing public support,
- → improving policy and regulatory framework,
- → setting up knowledge sharing capacities, initiating landscape partnerships for multi-stakeholders coordinated restoration,
- \rightarrow accelerating relevant innovation, and
- → strengthening market and financing market mechanisms.

The Strategy is envisioned as a foundation for these cooperation points that will further develop after the project MERLIN finishes. It envisions the agriculture sector Community of Practice (CoP) forming during 2025-2026 to implement the Strategy's outlined actions. Although suggested leadership for implementing the Strategy is divided in the actions, champions within all actors' groups should take ownership, ensuring the Strategy aligns with sector interests while balancing restoration and economic viability.

Engaging Member State authorities and EU policymakers is critical to secure regulatory support and financial backing, bottom-up sector efforts with top-down policies for successful long-term implementation. Despite the challenges in building a CoP for the agriculture sector (Schulz et al., 2024), this Strategy provides a roadmap for collaboration, multi-stakeholder engagement, and shared responsibilities in transforming the sector.

Next Steps include:

- → Immediate Focus (2025-2026, i.e., within MERLIN's timeframe) that include:
 - → Share the Strategy with organizations that contributed to its development, as well as those expressing interest in participation but unable to engage during the process.
 - → Propose additional bilateral discussions with key strategic actors at both EU and Member State levels, such as sector representatives, to discuss relevant sectoral developments and explore opportunities for future collaboration on the ideas and actions outlined in this Strategy.
 - → Develop academic papers to provide insights for researchers interested in the role of agriculture in mainstreaming NbS for freshwater restoration.
 - → Explore opportunities to present key aspects of this Strategy at scientific conferences and core forums relevant to the sector.
 - → Consider convening a final roundtable to engage stakeholders, strengthen the Community of Practice (CoP), and foster collaborative discussions.
- → Long-Term Vision (Beyond 2026): strengthen the CoP and foster landscape partnerships, secure financial and regulatory mechanisms to support sectoral transition.

This strategy could help key stakeholders see how to build on changes already underway within the Sector, to mainstream, guide and accelerate change. Long-term success will rely on sustained commitment from local, national and European stakeholders beyond the MERLIN project's conclusion.





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Annex: List of RTs participants

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