Briefing for Agriculture Sector

Authors: *Eva Hernandez Herrero, Solen le Clech, Jana Vítková, Anna Bérczi-Siket, Kirsty Blackstock*

Mainstreaming aquatic restoration using Nature-based Solutions: Supporting Sectoral Transformation

A collaborative approach with key economic sectors is essential to enable the H2020 MERLIN project to promote systemic transformative change. We will co-develop transformation strategies with different sectors to **mainstream restoration as a Nature-based Solution (NbS)**. Working with nature at landscape scale can contribute to the EU Green Deal objectives (climate resilience, improved biodiversity, zero pollution, sustainable food systems, health, and wellbeing).

> NbS has been defined by the International Union for Conservation of Nature (IUCN) as "actions to **protect, sustainably manage,** and **restore** natural or modified ecosystems, that address **societal challenges** effectively and adaptively, simultaneously providing **human well-being** and **biodiversity benefits**".[1]

This briefing focuses on the **Agriculture Sector**. It summarises MERLIN's understanding of the sector's current connection with rivers and wetlands, and how Nature-based Solutions (NbS) are viewed within the sector at the start of the collaboration. The briefing proposes how MERLIN (for more information visit www.project-merlin.eu) can support the Agriculture Sector to implement NbS.

How can MERLIN support transformation?

The Agriculture Sector can play a crucial role in contributing to reach Europe's Green Deal objectives, besides contributing to sustainable food systems. In particular, responding to extreme events such as recent floods, droughts, and heat waves. Transformation whereby NbS becomes the new normal will only happen through multiple actions involving government, markets and citizens. MERLIN will support this through understanding how and why the Agriculture Sector is already making positive changes, sharing good practice between European countries and exploring how NbS could help overcome some of the challenges faced by the sector. The briefing is based on a range of insights from involving individuals actively engaged in the Agriculture Sector (using questionnaires, interviews, and participating in sector meetings) and a desktop review of formal documents. We are very grateful for the insights shared to date, which have helped us understand the different positions. The synthesis provided in this briefing reflects the views of the authors and does not imply consensus within our developing **Community of Practice**. Our Community of Practice concerns EU and Member State level policy and commercial actors of the Agriculture Sector who share a common interest in improving their practices through regular interaction and sharing information.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

Relationship of the Agriculture Sector with freshwater restoration and NbS

Brief description of the sector

The Agriculture Sector is a highly heterogeneous sector across the EU. It consists of establishments primarily engaged in growing crops, raising animals, and harvesting food or fibre from a farm, ranch, or their natural habitats. The Agriculture Sector and its major activities are dependent on the geographical context, including the climate and the various forms of land uses and farm structures. The Agriculture Sector comprises sub sectors that include arable farming, livestock, agroforestry-forestry, fishing and aquaculture – in MERLIN we are focussed on **crop and livestock farming**. Food production, and thus EU food security, is important for the sector.

Almost 40 % of EU land, 173 million hectares, were used for agricultural production in 2016, Of the EU's 10.5 million farms, the majority are small (under 5 hectares) with relatively low standard outputs and covering only about 25 % of the total agricultural area. In contrast, 304,000 large farms (3 % of the EU total) each produced a standard output of EUR 250,000 per year or more in 2016 and were responsible for a majority (55.6 %) of the EU's total agricultural economic output. This diversity has to be considered when encouraging uptake of NbS at scale. The number of farms in the EU has been in steep decline, but the amount of land used for production has remained steady. Agriculture remains a big employer within the EU; 9.7 million people worked in Agriculture in 2016. However, as the number of farms in the EU has declined, so has the number of farmers and those employed in Agriculture, falling from 5.7 % of total EU employment in 2005 to 4.4 % in 2016[3]. The sector has to face market competition that further threatens small-scale farmers[4], as global market competition tends to favour large scale production and cheap labour[5]. Concerns over rural depopulation and the need to safeguard food security explains why successive Common Agricultural Policy reforms still contain elements of income support to maintain rural populations as well as competitive food export conditions.

The sector faces various economic, social and environmental challenges that undermine food systems and increase the pressures on natural resources: Copa-Cogeca[6] warns of the "difficult debates" coming up on "generation renewal, low farm income, market volatility and climate change".

Climate change is intrinsically linked to water, a resource the sector is highly dependent on: soil, ground and surface water for rain fed or mechanical irrigation. It is the second main source of water extraction in the EU[7]. accounting for 24% of water use on average in Europe, with some catchments in Southern Europe reaching 90%[8]. **To provide agricultural land with sufficient water**, using dams, or to reclaim land using drainage, farmers have altered the hydromorphology of wetlands, streams, peatlands, rivers and floodplains, which can reduce resilience to extreme weather events on farm and downstream. Agricultural production also affects water quality. Despite the increasing shift of the sector towards more sustainable practices, Agriculture is still the largest contributor of nutrient pollution to groundwater[6]. It generates diffuse pollution from nutrients and pesticides as well as sediments[9]. The effects of Agriculture on water quality obviously depend on the geographical context, farming system and management practices, e.g., extensive VS intensive management, organic VS conventional cultivation[10].

Coupled with climate change, Agriculture's pressure on natural resources leads to the degradation of the (agro)-ecosystems, affecting agricultural production and productivity and the sector's adaptation capacity. Changes in climatic conditions and extreme events related to climate change have affected crop yields and livestock productivity in Europe, with regional variations. For instance, droughts and heat waves have increasingly affected costs and caused economic losses in Agriculture[11]. Future climate projections reveal potential increase in yield loss, in some European regions[12]. Crop productivity has also been affected by changes in plant phenology and the time of flowering induced by climate change, as it has disturbed interactions between plants and pollinators[13]. Agriculture, at the same time, also contributes to climate change, e.g., through the release of greenhouse gases[14].

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 the transition towards sustainable food systems by aiming at improving the environmental and climate

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

performance of European Agriculture. The Farm to Fork Strategy aims at having 25 % organic land by 2030, from around 9 % of total utilised agricultural area in 2020[15] – this is one strategy to combat the negative impacts of some farming practices on water bodies and their biodiversity. Measures also exist at the Member States level, e.g. farm-level nutrient planning, setting aside buffer strips or fertiliser standards, leading to a general improvement of water quality in the European rivers. Whilst the sector seeks to improve its environmental standards, they are also seeking more funding to do it.

NbS and their potential for supporting the sector

In MERLIN, we understand NbS as working at the landscape or basin scale, to connect farmed land to the natural wetlands, floodplains and natural channels that provide many ecosystem services (from downstream provision of drinking water, regulation of flood peak speeds, supporting biodiverse food webs and cultural or health benefits from recreation). This understanding shows that NbS can be used to achieve different goals within the Agriculture landscape.[16] (1) Sustainable production practices such as agroforestry and windshields can be used to increase food production, while reducing the conventional Agriculture practices. (2) Measures such as wetlands, riparian buffers and grass strips could regulate water, control soil erosion and stabilise slopes. (3) NbS could enable the removal of pollutants and rehabilitation of degraded lands. This process helps agricultural lands to function as carbon sinks, pollinators or pollution control. (4) Finally, as a conservation function, NbS can enable the sector to improve biodiversity and ecological connectivity across landscapes. Overall, it offers the opportunity for the Agriculture Sector to use nature to rehabilitate landscapes affected by agricultural activities.

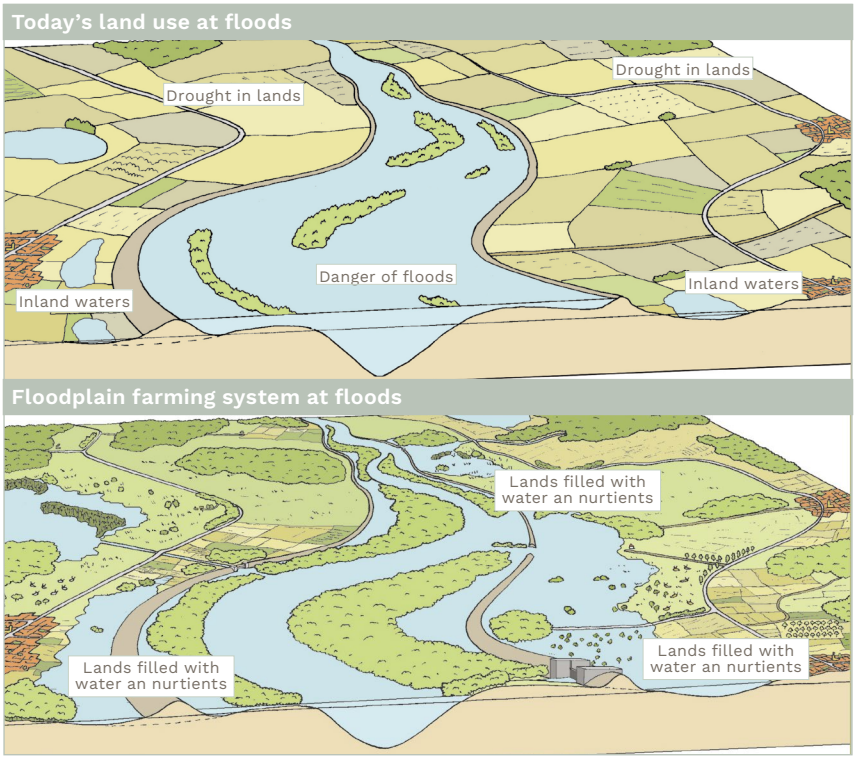

Figure 1: NbS for reconnecting floodplains[17]

As shown in Figure 1, a coordinated approach across multiple farms is needed to generate landscape, or basin scale, outcomes to reduce diffuse pollution, mitigate floods and help protect against droughts. These linked aquatic habitats also provide blue carbon benefits for climate sequestration and biodiversity, helping to meet Green Deal Goals. Innovations like paludiculture may allow farming and floodplains or peatland to co-exist. Paludiculture helps to productively sustainably use drained agricultural lands.

However, much of the discussion of NbS to date has focussed on farm measures aiming to improve soil water and fertility. These are important, but NbS need to consider the complex ecosystems that extend beyond the farm boundaries as illustrated in Figure 1.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

How the sector currently understands NbS

Both in interviews and in sectoral agricultural meetings, most of the participants said to be aware of the meaning of NbS, however, a diverse set of understandings was put on the table (e.g. NbS as a new terminology that reflects traditional practices, such as agroforestry, intercropping, crop rotation, cover cropping, and traditional organic composting, that have less impact on the environment than modern intensive practices; or NbS as a very abstract concept). Most of the participants connected NbS to, e.g., the concept of sustainability, or to circularity, resilience, sustainable intensification, by linking the terminology to improved human-nature relations. The agricultural stakeholders that were more familiar with the NbS approach were able to present a formal definition by FAO. NbS was also literally understood as engineering with nature. Some stakeholders did not feel comfortable with the IUCN and EU Commission definitions as they did not suit the needs of the sector and proposed to come up with a new one that better suited their needs. Something in which most of them agreed was that there was resistance towards NbS with the sector. This was because NbS was seen as something for nature but not solving farmers' problems.

Good examples of NbS for the Agriculture Sector

- → **Dutch example**[19] the room for the river program rewets the floodplain to slow the flow from extreme weather events and is already contributing to climate adaptation. Lands are flooded in the winter but allow grazing activity the rest of the year. Those programs are combined with agri-environmental measures (e.g. conservation of water salamanders) to give extra financial support to the farmers. The project works with groups of farmers to work at scale. See more about it **Case study 04** – https://project-merlin.eu/cs-portal/case-study-04.html
- → **Spanish example**[20] shows a successful system of ditches that promote biodiversity and allows watering of areas for livestock production. The water filters along the ditches creating small wetlands and meadows. In areas of high permeability, the water from the ditches is deliberately dumped to recharge semi-artificial aquifers whose water flows in springs at the level of the villages or flows into the main river. The system of water sowing and harvesting that guarantees water security, which provides food security to local communities, It serves to regulate water resources with effects in the watershed and downstream. They have become a cultural landscape and are a tourist attraction.
- → **Slovakian example**[21] Intercropping different agricultural production affects water resources on farms and in the water catchment. A rolled cover crop mulch can shade the soil, keeping moisture in it and protecting it against water erosion and overheating. No ploughing implies that soil capillaries are not destroyed, and the water infiltrates well in the soil, even in heavy rain. Additionally, some legume cover crops can fix Nitrogen, maintaining or improving water quality on farms and in larger areas. The cover crops also help biological activity in the soil, creating a good environment for microorganisms and pest predators. To be most effective, these practices need to be taken up widely by farmers to generate downstream positive benefits.

Challenges and Opportunities of the Agriculture Sector

Rural areas face the dual challenge of meeting the demand for food, and to reduce the negative impact of agricultural production practices on the environment. To meet a diverse range of human needs by 2050, the global agricultural sector needs to **provide food** for an estimated world's population of about 9.6 billion (or 8.5 billion according to the last estimations from the Club of Rome). The agricultural sector in Europe is overall dealing with a number of **environmental, social, and economic challenges** including biodiversity loss, and the decrease of pollinators, unreliable and polluted water supplies, soil erosion, and flood damage that impact their ability to produce food within the safe operating space of the **planetary boundaries**. In particular, **climate change** is at the core of a number of environmental, social, and economic challenges that the agricultural sector faces, which is projected to have considerable effect on **food production** and livelihoods. While areas suitable for food production might change across Europe, increasing in some areas and decreasing land capability (due to saturation or aridity) in others. Climate change increases temperature and alters the supply and demand of water regionally, increasing the competition between the agricultural sector and other sectors.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

Agriculture is too often one driver of land and soil degradation and of the **depletion of natural resources** and biodiversity[22]. These dynamics lead to the decline of the provision of several ecosystem services, including pollination[23] and soil erosion control[24]. Yet, those services are critical for food production and the rural stakeholders. Rural areas face the dual challenge of meeting the demand for food, and to reduce the negative impact of agricultural production practices on the environment. Therefore, the sector needs solutions, ideally NbS to respond to these challenges and maximise the global opportunities. In particular, where farmers are managing their environments well, they believe they are not receiving due market value for these actions. Therefore, the whole food value chain – determined by the market, demands and cost – can play a significant role in valorising NbS. As business strategy is key to farmers, alternative solutions should be provided to ensure continuous production of nutritious food at affordable prices.

NbS in farming systems can lead to the **maintenance and enhancement of several environmental conditions** and parameters, which in turn would be beneficial for **resilient and stable agricultural outputs**. For instance, NbS could contribute to **healthier soils**, that are critical components of resilient agricultural production, e.g., through its importance in control on microbial activity and nutrient recycling. NbS could play an important role in restoring soil quality, with increased carbon content and high infiltrability rates and water available for plants, that would lead to enhanced agricultural productivity and sustainability. Feedback loops might occur when enhancing one environmental condition, positively impacting others and being highly beneficial for the agricultural yields.

Challenges

- **Lack of common terminology.** The term 'NbS' may be understood at some governance level, e.g., the policy level, but not necessarily at all levels, e.g. the practical level. This misunderstanding results from the diverse terminology that is adopted among the different stakeholders. Other terminology might be used by farmers and (existing) farming practices might achieve the same goals as envisaged by policymakers and aimed by NbS, but under a different label (e.g., agroecology, biodynamic agriculture, organic farming).
- **Lack of environmental awareness**, incl. water related issues and lack of knowledge on NbS that can lead to the opposition to the NbS of the farmers, and a lack of willingness to change. Although most farmers know about their land and are aware of some practices that aim at improving natural resources and of the importance of managing water in a sustainable manner for business sustainability and resilience, their knowledge in all potential benefits provided by NbS and in all alternative practices that could maintain or enhance the environmental conditions might be limited.
- **Uncertainties** of the results of NbS /water restoration. The actual benefits of NbS/ water restoration, especially under climate change, at the farm level are unknown, and therefore the NbS may be unattractive for risk-averse farmers.
- **Lack of an enabling environment**, i.e. of institutional and financial support to locally implement new practices and NbS on a large scale and in a collaborative way.
- **Mismatch in time and spatial scales** of application of NbS: mismatch between changes in local farming practices and their long-term impact on broader (neighbouring) water systems. The location of NbS at the watershed does not fully overlap with the farm spatial extent, which implies the need of connecting farmers among themselves, and with the stakeholders responsible for the management of the watershed, and with stakeholders from other sectors. However, policies are sectoral and might prevent such collaboration across sectors.
- **Monitoring and performance assessment:** the indicators used for the monitoring, the identity of people conducting the monitoring, the way performance should be rewarded – are still unknown.
- **Land tenure:** some farmers are tenants and their decisions on the land they use are limited. Further, NbS being long term solutions, the benefits of their implantation might take longer than the duration of the lease.
- **Scarcity of agricultural land** that is oftentimes rented or hired. This is a barrier to implementing NbS as with experimental fields for NbS, a stakeholder loses a certain plot of field to produce foods, reducing areas for food production while paying for the land they are renting.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

→ Farming practices and NbS are **context-specific** (environmental and socio-economic characteristics): this poses the problem of up- and out-scaling of locally-thought solutions and applicability of regionally-thought solutions.

Opportunities

The main opportunities from NbS are as follows:

→ NbS can be implemented through the adoption of **already existing agricultural practices**. For instance, the reduction or absence of tillage and an increase in soil cover, can contribute to achieve the goals of the NbS and meet some of the EU policy goals. Carbon farming can support high carbon stocks in soil, while protecting biodiversity and enhancing soil quality. It also helps to retain water in soil and prevent flooding. These are already being implemented. The adoption and implementation of alternative farming practices and of NbS can be facilitated **by Eco Schemes and agri-environmental and climatic measures**.

→ Development of the climate resilience of the Agriculture Sector strongly depends on the **landscape-scale transformation of the land use system**, providing space for NBSs preventing further soil degradation and fostering recovery, mitigating water scarcity and floods, stabilising the micro climate, etc. To reach this goal there is a **strong need to integrate land use and water management strategies**, aiming the optimization of resource management and the regenerative development at scale.

→ NbS could support the emergence of **new value chains** particularly making more market value from good environmental stewardship of water on farms and across the basin – including using existing certification to increase visibility or gain premiums from the buyers[25].

→ Investment in NbS would support the maintenance or regeneration of several ecosystem services, promoting **multifunctionality** of agricultural areas, and support the **resilience** of farms over time, especially preventing soil loss from flooding and holding water on the land for use in summer droughts.

→ The carbon benefits of some NbS measures, including **restoring degraded organic soils**, can be financed through carbon credits and help deliver the targets for the agricultural sector.

→ Increasingly, public funding for Agriculture is being justified through **delivery of public goods**, such as the Green Deal goals of climate action and biodiversity restoration so adopting NbS as part of a farming business model will enable farmers to align themselves with CAP strategic plans and benefit from relevant eco schemes.

Cooperation (MERLIN & the Agriculture Sector)

Whilst many different aspects of how the Agriculture Sector might mainstream NbS were discussed, we would like to focus on **the enabling environment** that can support coordinated or collective action across farms and help farmers benefit from adopting NbS. To mainstream such an NbS approach, several issues were identified and are listed here for discussion and lead into the route map and sectoral strategies. In the MERLIN project we will focus our work with the sector on the issues in bold:

Illustrate the benefits of NbS

→ By supporting the implementation of a consistent terminology and linking the current and potential farming practices to the framework of NbS

→ To transform the belief that farmers bear the costs of implementing NbS but wider society gains the benefits rather than farmers. To change these perceptions, Illustrate the multiple benefits of NbS, e.g. by making use of Cost-Benefit Analyses;

→ Mapping/modelling how NbS impacts the agricultural business models in a landscape context (e.g. risk reduction, effects on yield change)

↘ A number of online tools exist that can help illustrate the benefits of interventions (e.g. CAPRI26) that can be used to inform policy discussions but to get impact on the ground, these need to be employed in a participatory fashion with the land managers. **Screening restoration needs by farm type could be a first step to see how MERLIN NbS interact with business objectives.**

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

- → Provide evidence of NbS for delivering ecosystem services and enhancing farms' resilience, in the short and long term.
- → **Share successful case studies (learn from MERLIN case studies, their twins, and others), covering different realities (and challenges for the sector) across Europe**
  - ↘ Including alternatives to current production in wetlands and peatlands – more case studies and knowledge sharing about paludiculture might be beneficial to address the issue of Agriculture on restored peatlands.

Build capacity and knowledge sharing opportunities

- → Build on the Agricultural European Innovation Partnership (EIP-AGRI) NbS focus group to maintain a Community of Practice were the sector feels well represented, a safe environment where trust among the different participants can be developed, to speak freely and confidently
- → **Develop consortia models to bring together stakeholders often working separately, e.g., resource managers, farmers, value-chain operators, policymakers.**
  - ↘ These require an integrated landscape-based or watershed-based approach to bridge mismatches between farm and basin scale to address landscape multifunctionality and resilience (not only related to water issues).
- → **Share information about the practical / technical and decision-making aspects of NbS implementation from MERLIN case studies. Ensure this takes account of the socio-economic and ecological context to consider how it can be transferred to other farm systems and weather patterns.**
  - ↘ Involve farmers in the (re)design, implementation, and monitoring of NbS could transform the perception society has of the farmers (not to be the polluters anymore).

Adapt or create policies and products

- → **Explore 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**
- → **Explore the implementation of eco-schemes to organise collective action to implement NbS in a group of farms**
- → **Explore a NbS certification as an add-on module to organic certification or stand-alone certification. The use of certification would allow for the farmers to be acknowledged for adopting NbS**
- → **Support NbS is well integrated into the CAP and related Country Strategic Plans:**
  - ↘ Via conditionalities for direct payments under the first pillar. For example, by using NBS to meet Good Agricultural and Environmental Conditions (GAEC) 2, which requires protection of wetlands and peatlands
  - ↘ Strengthen and promote relevant CAP eco-schemes
  - ↘ Ensuring that funds available under the second pillar of the CAP for rural development are used to mainstream NBS solutions e.g. through Agri-environment climate measure and knowledge sharing activities.
  - ↘ consider the role of Agriculture in protected organic soils through integrating peatland restoration better into CAP and agricultural policies

This will allow us to move from a broad understanding of the sector to a more focussed and therefore in-depth engagement with the sector regarding which barriers to remove and which opportunities to exploit.

Cross sectoral: NbS relying on certified nature-inclusive agriculture would be beneficial for nature conservation. It will support the regulation of several biophysical cycles and therefore contribute to better water quality, and could also contribute to the regulation of water levels, which would be favourable for **Hydropower, Navigation, Water Supply** but also **Insurance Sectors** (also by increasing the resilience of the farming systems). As many degraded peatlands are used for agricultural production, adopting NbS will complement efforts by the **Peat Extraction Sector** to revegetate and improve the peatland functions. Furthermore, the horticulture part of the sector can continue to work with the **Peat Extraction Sector** to find alternatives to peat based growing media. As above, MERLIN will consider if agricultural insurance can help farmers manage extreme events using NbS.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.

Next Steps

Overall, we are building a Community of Practice to support an understanding of NbS and how we can enable mainstreaming of NbS in the agricultural sector; as well as how the agricultural sector can work with other sectors

Together with participants from the six sectors, in the next year MERLIN will:

→ Continue to engage with the sector to exchange ideas and develop understanding of their needs, challenges, and opportunities for NbS.

→ Examine the EU policy context and how in the future policy could better enable NbS.

→ Incorporate issues of social justice alongside ecological and economic considerations in the process to mainstream NbS within the sector.

In the longer term until the end of the project MERLIN will:

→ Identify opportunities for cross sector partnerships by applying a value chain approach.

→ Co-develop route maps for transforming the sector's relationship with NbS.

For more information on how we will collaborate with the sectors' representatives or to discuss how you can help MERLIN please contact
Anna Bérczi-Siket (Anna.Berczi-siket@wwf.hu) or
Kirsty Blackstock (Kirsty.Blackstock@hutton.ac.uk).

For MERLIN Agriculture Sector specific questions or queries please contact
Eva Hernandez Herrero (ehernandez@wwf.es) or
Tamas Gruber (tamas.gruber@wwf.hu).

References

1 Cohen-Shacham, E., Walters, G., Janzen, C., & Maginnis, S. (2016). Nature-based solutions to address global societal challenges. IUCN: Gland, Switzerland, 97, 2016-2036.

2 This overview of the Agriculture Sector in the EU is based on overall statistics for the entire EU that might not reflect the situation in individual countries. European Commission (2020). Farms and farmland in the European Union – statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics

3 Access to Land. Background: Land. https://www.accesstoland.eu/Background-Land-23

4 Thomsen, Berit (2016). CETA's threat to agricultural markets and food quality. Friends of the Earth https://friendsoftheearth.eu/wp-content/uploads/2016/10/10_cetas_threat_to_agricultural_markets_and_food_quality.pdf

5 Benton, T., & Bailey, R. (2019). The paradox of productivity: Agricultural productivity promotes food system inefficiency. Global Sustainability, 2, E6. doi:10.1017/sus.2019.3. https://www.cambridge.org/core/journals/global-sustainability/article/paradox-of-productivity-agricultural-productivity-promotes-food-system-inefficiency/4D5924AF2AD829EC1719F52B73529CE4

6 Copa and Cogeca – The European Voice of Farmers and Agri-Cooperatives. https://copa-cogeca.eu/?lang=en

7 European Economic Area (2018) European waters – Assessment of status and pressures 2018. Available at: https://www.eea.europa.eu/publications/state-of-water.

8 European Court of Auditors (2021). Special Report: Sustainable water use in agriculture: CAP funds more likely to promote greater rather than more efficient water use. https://www.eca.europa.eu/Lists/ECADocuments/SR21_20/SR_CAP-and-water_EN.pdf

9 European Court of Auditors (May 2019). Audit preview Information on an upcoming audit: Biodiversity in Farming. https://www.eca.europa.eu/lists/ecadocuments/ap19_09/ap_biodiversity_en.pdf

10 European Union (2020). Evaluation of the Impact of the CAP on Water. EEIG Alliance Environment. ISBN 978-92-76-10939-6, doi:10.2762/63371.

11 Stahl, K., et al. (2016). Impacts of European drought events: insights from an international database of text-based reports. Nat. Hazards Earth Syst. Sci., 16(3), 801–819, doi:10.5194/nhess-16-801-2016.

12 van der Velde, M., et al., 2018: In-season performance of European Union wheat forecasts during extreme impacts. Sci. Rep., 8, doi:10.1038/s41598- 018-33688-1.

13 Bednar-Friedl, B., R. Biesbroek, D.N. Schmidt, P. Alexander, K.Y. Børsheim, J. Carnicer, E. Georgopoulou, M. Haasnoot, G. Le Cozannet, P. Lionello, O. Lipka, C. Möllmann, V. Muccione, T. Mustonen, D. Piepenburg, and L. Whitmars (2022), Europe. In: Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 1817–1927, doi:10.1017/9781009325844.015.

14 European Environment Agency (2017). Climate change, impacts and vulnerability in Europe 2016 — An indicator based report, EEA Report No 1/2017, European Environment Agency (https://www. eea.europa.eu/publications/climate-change-impactsand-vulnerability-2016).

15 European Commission (2022). EuroStat: Organic Farming Statistics. https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Organic_farming_statistics

16 Simelton, E., Carew-Reid, J., Coulier, M., Damen, B., Howell, J., Pottinger-Glass, C., & Tran, H. (2021). NBS Framework for Agricultural Landscapes. Frontiers in Environmental Science, 9. doi:10.3389/fenvs.2021.678367.

17 Figure 1: Kiss Maja. Palocsa–SZÖVET (2001-2007): Kulcs a Tiszához I–II. DVD borító.

18 Food and Agriculture Organization of the United Nations (2018). Nature Based Solutions for Agricultural Water Management and Food Security. Land and Discussion Paper 12, pages 23 and 29. ISBN: 978-92-5-131125-7. https://www.fao.org/documents/card/es/c/CA2525EN/

19 Rijkswaterstaat Ministry of Infrastructure and Water Management. Room for the River. https://www.rijkswaterstaat.nl/en/about-us/gems-of-rijkswaterstaat/room-for-the-river

20 Martos-Rosillo, S.; Ruiz-Constán, A.; González-Ramón, A.; Mediavilla, R.; Martín-Civantos, J.M.; Martínez-Moreno, F.J.; Jódar, J.; Marín-Lechado, C.; Medialdea, A.; Galindo-Zaldívar, J.; et al. The oldest managed aquifer recharge system in Europe: New insights from the Espino recharge channel (Sierra Nevada, southern Spain). Journal of Hydrology. 2019, 578, 124047.

21 European Commission, EIP-AGRI communication (22 March 2022). EIP-AGRI Focus Group Sustainable ways to reduce the use of pesticides in pome and stone fruit production 1st meeting. https://ec.europa.eu/eip/agriculture/en/event/eip-agri-focus-group-sustainable-ways-reduce-use

22 Dudley, Nigel & Alexander, Sasha (2017). Agriculture and biodiversity: a review, Biodiversity, 18:2-3, pp. 45-49, DOI: 10.1080/14888386.2017.1351892.

23 European Court of Auditors (2020). Protection of wild pollinators in the EU — Commission initiatives have not borne fruit – Special Report 15. https://www.eca.europa.eu/Lists/ECADocuments/SR20_15/SR_Pollinators_EN.pdf

24 Power, Alison G. (27 September 2010). Ecosystem services and agriculture: trade-offs and synergies. The Royal Society Publishing. https://doi.org/10.1098/rstb.2010.0143

25 Resilient Dairy Landscapes. https://www.resilientdairylandscapes.com/the-project

26 Barreiro Hurle, J., Bogonos, M., Himics, M., Hristov, J., Perez Dominguez, I., Sahoo, A., Salputra, G., Weiss, F., Baldoni, E. and Elleby, C., Modelling environmental and climate ambition in the agricultural sector with the CAPRI model, EUR 30317 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-20889-1 (online), doi:10.2760/98160 (online), JRC121368.

The MERLIN project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 101036337.