

**Horizon Europe, cluster 6 ‘Food, Bioeconomy, Natural Resources,  
Agriculture and Environment’**

*Outline of the work programme 2021-2022*

**Please note that:**

- **The ‘orientations for topics’ listed in this document are preliminary and are meant only to illustrate the expected content of each destination. The impacts and issues listed in this document are preliminary.**
- **Not all impacts and issues listed in this document will be included in the first work programme.**
- **The number of issues and impacts listed in the document is not an indicator for the number of topics to be included in the first work programme, nor for the budget allocation to the different areas.**
- **The presentation of impacts and issues to be supported under European Partnerships is indicative and does not prejudice any future decision.**
- **This document does not address how Cluster 6 will contribute to Missions.**

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## Introduction

Horizon Europe mandate to Cluster 6 is to provide opportunities to balance environmental, social and economic goals and to set human activities on a path to sustainability. The underlying paradigm of Cluster 6 is therefore the need for a transformative change of the economy and society to reduce environmental degradations, to halt the decline of biodiversity and to better manage natural resources while concretely serving the EU climate objectives and ensuring food and water security. The Strategic Plan [include foot-note when text adopted] has identified six long term targeted impacts where Cluster 6 will make a difference.

This Cluster has the potential to accelerate the ecological transition required by the Green Deal in order to achieve climate neutrality by 2050, by enhancing Earth's natural carbon sinks such as soils and plants, forests, farmed lands and wetlands, by reducing GHG emissions notably from the agricultural sector, by transforming the food system and by innovating to develop the circular economy, reduce the EU's dependence on non-renewable resources and exploit the potential of biological resources for renewable products. R&I will support the objectives of the Circular Economy Action Plan, the EU industrial Strategy, the Bioeconomy Strategy, the EU Forest Strategy, the Blue Growth Strategy, the Chemicals Strategy for Sustainability and the EU Plastics Strategy.

Protecting and restoring the integrity of ecosystems, and their capacity to deliver a wide range of essential services, thus putting Europe's biodiversity on the path to recovery by 2030 as required by the EU Biodiversity Strategy is fundamental to achieve the Green Deal. R&I will address the multiple challenges in this area, including by enabling transformative changes. This Cluster deals with agriculture, forestry, aquaculture and fisheries, food and bio-based systems, which directly depend on ecosystem services. They have profound environmental impacts and at the same time are particularly affected by the global environmental changes. Their transformation will have to consider in particular climate adaptation needs.

Cluster 6 will steer and accelerate the transition to sustainable, healthy and inclusive food systems to make the objectives and targets of the Farm to Fork Strategy achievable. It will notably empower farmers, fishers and aquaculture producers to transform their production methods more quickly, and make the best use of nature-based, technological, digital and social innovations to deliver better climate and environmental results, increase climate resilience, reduce their dependency on pesticides, antimicrobials and excess fertilisation, while providing consumers with affordable, safe, nutritious, healthy and sustainable food. R&I will also stimulate safe and sustainable food processing, wholesale, retail, hospitality and food service practices and facilitate shift to sustainable healthy diets. R&I will also support the design, implementation and monitoring of the Common Agricultural Policy, the Common Fisheries Policy and the EU General Food Law.

Improved knowledge and innovations will be key for the success of the Zero-Pollution Ambition of the EU Green Deal, to halt and prevent pollution, addressing issues concerning fresh and marine waters, nutrients as well as the environmental performance of processes. R&I will support EU environmental legislation and policies targeting high level of protection for

biodiversity, soil, water, air and marine resources, including the Nature Directives, the Pollinators Initiative and the EU Water Framework Directive as well as the Maritime Policy and the EU Arctic Policy.

The Cluster will support the development of resilient and vibrant rural, coastal and urban areas in line with the priority “ An economy that works for people”. It will develop new governance models ensuring that no one is left behind to implement the Green Deal initiatives, necessary to ensure a fair and just transition. Advantage will be taken of the use, uptake and deployment of Environmental Observation as well as digital solutions in coherence with the EU priority “A Europe fit for the digital age”. Opportunities of the post-Covid-19 crisis recovery agenda will be seized to set the economy on a path to sustainable development in line with the UN 2030 Agenda.

Cluster 6 activities will sustain the ambition of the EU on international fora in areas of paramount importance such as biodiversity, the management of natural resources, sustainable agriculture and food security.

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## **Destination 1 – Biodiversity and Ecosystem Services**

The EU Biodiversity Strategy for 2030 is a cornerstone of the European Green Deal that will put Europe’s biodiversity on the path to recovery by 2030, for the benefit of people, climate and the planet. It will also prepare the EU to take a leading role in the upcoming international negotiations on a new global framework to halt biodiversity loss. With the Green Deal’s ‘do no harm’ vision, all EU policies will become more biodiversity-friendly, focusing more on the sustainable use of ecosystems, and supporting recovery in a post-pandemic world<sup>1</sup>. This policy vision is fully supported in the Strategic Plan of Horizon Europe For 2021-2024 in its first key strategic orientation ‘Protecting and restoring ecosystems and biodiversity and managing sustainably natural resources on land and at sea, and achieving climate neutrality and adaptation’.

Research and innovation is key to delivering important impacts in the nexus biodiversity-food-health-water-climate and to achieving the goal of healthy and resilient ecosystems by 2030. It will also enable transformational change engaging European society and economy and their global impacts, making decisions more biodiversity-friendly. R&I will support policy targets, develop nature-based solutions and holistic approaches to address the main causes of biodiversity loss, particularly in connection to production systems, bringing all sectors to be integrated in ecosystem-based management. Investments in R&I will help to protect and restore the integrity of terrestrial, aquatic and marine ecosystems, currently under multiple pressures, and their capacity to deliver a wide range of essential services. Under Horizon Europe, a long-term strategic research agenda for biodiversity and a pan-European Biodiversity Partnership will also be developed. The ultimate objective is to put biodiversity on the path of recovery and enable the restoration of ecosystems towards reaching the global vision for biodiversity 2050 “Living in harmony with nature”.

Several Missions will also contribute to achieve biodiversity-related impacts, notably in the areas of “Healthy oceans, seas, coastal and inland waters” and “Soil health and food”.

### Expected impact

Proposals for topics under this Destination should set out sound pathways to contributing to the following expected impacts:

- Biodiversity decline is halted in all European biogeographical regions, and ecosystems and their services are preserved and sustainably restored in natural and primary production systems on land, in inland water and at sea through improved knowledge and innovation.
- Direct drivers of biodiversity loss are understood and addressed.
- Biodiversity and ecosystem services in natural systems and in primary production are better understood, monitored, properly valued, managed and used.

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<sup>1</sup> COM/2020/380 EU Biodiversity Strategy for 2030: Bringing nature back into our lives

- The interrelations between biodiversity, health, food, water and climate are better known.
- Transformative change<sup>2</sup> is enabled: indirect drivers of biodiversity loss are tackled and ‘do not harm’ biodiversity policies are mainstreamed across sectors.

### Understanding biodiversity decline

The sixth mass extinction is taking place: one million species are at the risk of extinction, and degradation of ecosystems severely affects the fabric of life that enables the survival of humankind<sup>3</sup>. Our knowledge on biodiversity status, drivers, pressures, impacts and responses needs to be improved, and solutions for preventing and addressing the effect of direct drivers of biodiversity loss (land and sea use change, overexploitation, climate change, invasive species, pollution) need to be further developed and made available to policy makers and practitioners, such as through the new Knowledge Centre for Biodiversity to be set up. In particular, knowledge gaps on pollinators and marine biodiversity, including direct and indirect stressors of marine ecosystems, need to be urgently addressed.

Europe’s contribution to advances in global biodiversity science rely on the integration of data and knowledge from a wide range of biogeographical locations, disciplines and technologies. New tools and standards, as well as scenarios and models are necessary to connect policy needs with data-driven science, interconnected and usable by all, such as barcoding and other DNA-based identification systems, to track biodiversity change and provide information on species, functional biodiversity and ecosystems conditions. The next generation of citizen science and crowdsourcing tools is heavily relying on big data analysis and artificial intelligence, but also on behavioural, social sciences, communication and policy tools, for more impact on society and economic sectors.

The main expected impacts for this sub-area are:

- Biodiversity decline and its main direct drivers are better understood and addressed through the production and use of open data, knowledge, innovative technologies and solutions, in collaboration with European and international initiatives.
- Data and knowledge from different disciplines, types and origins is integrated and publicly available through the Knowledge Centre for Biodiversity.

For achieving these impacts, topics are considered addressing the following issues<sup>4</sup>:

- European participation in global biodiversity genomics endeavours aimed at identifying all biodiversity on Earth<sup>5</sup>.

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<sup>2</sup> Transformative change has been defined by IPBES as “A fundamental, system-wide reorganization across technological, economic and social factors, including paradigms, goals and values”.

<sup>3</sup> IPBES global assessment (2019). Summary for policy-makers.

<sup>4</sup> All types included: marine, inland waters and terrestrial ecosystems, habitats and species.

<sup>5</sup> Such as the *International Barcode of Life (iBOL) consortium*, <https://ibol.org/>, and the *Earth BioGenome Project global consortium*, <https://www.earthbiogenome.org/>.

- Genomics and taxonomic technologies for the inventory and fast identification of endangered wildlife and other species groups such as pollinators, plankton, migratory species, apex predators, corals and other habitat building species, pests, disease vectors, potential pathogens and invasive species.
- Systemic research, innovation, and monitoring on direct drivers of biodiversity loss.
- Development of fit for purpose smart methods, tools and frameworks for observing and mapping of terrestrial and marine ecosystems.
- Advance knowledge enabling the understanding and valuing of biodiversity, from microbiome to megafauna, ecosystems services, and develop a systemic approach for the integrated assessment of the cumulated impact of direct and indirect stressors on ecosystems health, processes and services.
- Close knowledge gaps on marine biodiversity.
- Develop a systemic approach for addressing the decline of pollinators, taking into account the major drivers and their interaction, at local and landscape scales.
- Invasive alien species: innovative methods and data generation for systemic management, including social aspects.
- Building research capacity, in particular near biodiversity hotspots and protected areas, through professional taxonomic expertise, networking and infrastructures from natural history museums and other biodiversity research centres.
- Advances in biodiversity research through, and consideration of impacts of, artificial intelligence, emerging technologies and citizen science.
- Integrating new and existing biodiversity data and knowledge from multiple origins on species status, ecosystem condition and specific species groups, including into new modelling and scenario approaches. Support to the Knowledge Centre for Biodiversity.

### **Valuing and restoring biodiversity and ecosystem services**

The continued degradation of the ecosystems and its services contributes to biodiversity loss, climate change<sup>6</sup>, and enhances the risk of severe ecological disasters and pandemics. The European Green Deal and its Biodiversity Strategy request urgent restoration efforts for damaged aquatic and terrestrial ecosystems to increase biodiversity and deliver a wide range of ecosystem services. Assessing and valuing the state of ecosystems and their services is necessary to guide and prioritise decisions and inform policies on environment, water, health, climate, agriculture, forest, bioeconomy, marine protected areas planning and management, and responsible business practices.

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<sup>6</sup> <https://www.nature.com/articles/s41558-020-0738-8>

The quantification of the contribution of ecosystems to human wellbeing and the economy is not properly accounted for in market transactions, planning, and investment decisions: social and economic co-benefits of healthy ecosystems are often disregarded. Natural capital accounts need to be developed and mainstreamed. Investments on R&I will also scale up and speed up the implementation of technological, societal and nature-based solutions (NBS). These support vital ecosystem services, biodiversity and biomass provision, as well as access to fresh water, improved livelihoods, healthy diets and food security from sustainable food systems. NBS deployment will also create green jobs and build resilience to climate change and natural disasters. Citizens, authorities, businesses, social partners and the research community must be engaged at local, regional, national and European levels.

The main expected impacts for this sub-area are:

- Ecosystems and their services in natural systems and in primary production are better understood, monitored, preserved, restored, valued and managed.<sup>7</sup>
- Assessment and trends of natural capital and ecosystems services is integrated into decision making in policy and businesses.
- Policy makers get support to determine how to prioritise, fund and deliver ecosystem restoration at scale throughout Europe.
- Nature-based solutions are designed, tested, implemented and deployed across Europe and beyond.
- Valuing, restoring, protecting and monitoring ecosystems and their services contribute to the implementation to policies, such as EU water related targets and the EU Biodiversity strategy, in particular in ecologically important degraded areas
- Science base is provided for maritime spatial planning and MPAs design with ad hoc flexible ecosystem based management.
- The relations between biodiversity and health are better understood; in particular, risks associated with microbiomes, and opportunities for biodiversity recovery are identified.

For achieving these impacts, topics are considered addressing the following issues:

- Further developing the knowledge base on ecosystems and their services in Europe (trends, condition, pressures), the understanding on when nature is in a good state, the requirements of different ecosystems, and their relationship with benefits such as climate regulation, water regulation, soil health or pollination.

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<sup>7</sup> This issue concerns all types of ecosystems, and will be developed in different topics covering aquatic, marine and terrestrial ecosystems.

- Identify the conditions to be met in order to protect and restore different terrestrial, aquatic and marine habitats and species in order to define the most effective measures and develop effective conservation and restoration methodologies.
- Contribute to a framework to assess the sustainability of the services and resources provided by the marine ecosystems.
- Better understanding of the mechanisms that link natural capital and ecosystem services to human well-being to assess both the value of benefits from nature and the ecosystems and the expenditure required to maintain their capacity to supply multiple benefits.
- Explore connections among biodiversity, ecosystems and human health: opportunities to enhance benefits and prevent risks for human health, and for biodiversity recovery.
- Contribute to innovative financing of Nature-Based Solutions<sup>8</sup> (NBS).
- Contribute to NBS valuation, evaluating its co-benefits for the protection of habitats, species and ecosystems, cost-benefit analysis, monetisation and non-monetary values. Better understanding of their social and economic consequences for just transitions.
- Support a science-based holistic maritime ecosystem management and spatial planning and the tools necessary to enable the protection and restoration of marine biodiversity and ecosystem services and their sustainable use.
- Large-scale demonstration of restoration and holistic ecosystem based management and governance of marine ecosystems and natural capital to achieve sustainable blue economy and societies, and their resilience in MPA and non-protected areas, with international cooperation.
- Natural capital accounting: from macroeconomic models to decision-making. Economic analysis, finance, bio-economic modelling. Methods, criteria and standards for ecosystem accounting in order to demonstrate how conserving biodiversity and restoring ecosystems deliver actual benefits for the economy. Test, pilot and mainstream NCA in EU member states and businesses.
- Comprehensive review of the knowledge about and past experience with effective approaches to aquatic ecosystem restoration.
- Demonstrate innovative approaches in the whole life cycle of restoration projects from identification to mobilization/engagement of stakeholders, funding, implementation, long-term maintenance and evaluation.

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<sup>8</sup> Nature-based solutions are “inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. - Hence, nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services.”

## **Managing biodiversity in primary production**

Biodiversity is the basis for sustainable and resilient agriculture and forestry. While diverse genetic resources allow the production of plants and animals adapted to different environments and meeting diverse needs, the interplay between species below and above ground delivers important ecosystem services, such as pollination and pest control.

Despite the recognised benefits of (bio)diversity, current production systems in agriculture and forestry tend to be specialised and to rely on a limited number of crops, breeds and forest tree species with a narrow genetic basis. Reversing this trend and increasing the resilience of farming and forestry is critical and of global concern in particular in the current context of accelerated climate change and a growing population with of an increasing footprint of production and consumption.

The main expected impacts for this sub-area are:

- Increased understanding of functional biodiversity (above and below ground) and how it can be sustainably managed and used to benefit primary production while delivering multiple ecosystem services;
- Increased understanding of the contribution of sustainable farming and forestry practices to increased (agro/forest)biodiversity;
- Insight into the characteristics of genetic resources; enhanced preservation of genetic resources and their use in breeding, farming and forestry;
- Availability of a wider range of crops and breeds with a broadened genetic base, catering for diverse production systems, consumer demands and wider ecosystem services;
- Diversity is embedded into sustainable production systems in agriculture and forestry and leads to more resilient primary production, dynamic value chains and healthy diets;
- Practices in agriculture and forestry support biodiversity and the provision of a wide range of ecosystems services such as pollination.

For achieving these impacts, topics are considered addressing the following issues:

- Expanding the knowledge base on functional biodiversity above and below ground, its use in sustainable primary production and the links between managed and natural biodiversity and ecosystem resilience;
- Improving understanding and measuring the contribution of agroecological practices and agroforestry to increased (agro-)biodiversity;
- Methods, capacity building and solutions for pollination services from wild and managed pollinators and sustainable pest control;

- Building capacities for preservation, characterisation and management of genetic resources taking due account of underutilised resources (including protein crops, land races, crop wild relatives and local breeds)
- Support to breeding and pre-breeding activities with a focus on characteristics conferring , resilience and quality and suited to sustainable production systems, including organic farming;
- Enhancing production systems in agriculture and forestry which build on and support biodiversity and the provision of a wide range of ecosystem services;
- Skills, strategies and policies for biodiverse agriculture and forestry including support to international commitments, such as the legal framework for access and benefit sharing under the Convention for Biological Diversity.

### **Enabling transformative change on biodiversity**

Science (IPBES and IPCC) and Policy (the global post-2020 biodiversity framework and the EU Biodiversity Strategy) clearly underline that biodiversity loss can only be successfully addressed if transformative changes will be initiated, accelerated, and up-scaled. There is however hardly any knowledge on potential and impact of transitions focused on biodiversity. The IPBES Global Assessment, drawing on socio-ecological and socio-technical system perspectives defines transformative change as “a fundamental, system-wide reorganization across technological, economic and social factors.” System-level change of this kind starts through social innovation, for example, the introduction of new technologies, new processes of production, consumer products, regulations, incentives, participatory processes, which change how socio-technical and socio-ecological systems operate and their environmental impact. Such transformative change must decrease the impacts of indirect drivers of biodiversity loss, which are in turn, underpinned by societal values and behaviours: Production and consumption patterns, human population dynamics and trends (including their footprints), trade, technological innovations, local to global governance (including financing). Research and innovation can enable these transformative changes to happen and initiate processes and actions which are transforming the way we impact biodiversity. Socio-economic and multidisciplinary research will develop knowledge and tools to understand the role of transformative change in biodiversity action, address the indirect drivers for biodiversity loss, and accelerate biodiversity-relevant transformative changes in our society.

The main expected impacts for this sub-area are:

- Indirect drivers for biodiversity loss and interactions with their underlying societal values and behaviours are understood and addressed.

- Approaches for enabling societal transformative changes necessary for halting biodiversity decline and for large-scale restoration of ecosystems and their services are identified, tested and implemented in policy, governance, business and society.
- Transformative changes in our society are accelerated: ‘do not harm’ biodiversity policies are mainstreamed across sectors.

For achieving these impacts, topics are considered addressing the following issues:

- Assess the indirect economic drivers for biodiversity loss (i.e. extraction, production, consumption, and trade, especially in primary production, energy and food systems), quantify their impacts and develop solutions.
- Understanding the role of behavioural patterns, beliefs, life style, religious and cultural values in decision making for creating a toolbox for transformative changes in biodiversity action.
- Understanding and addressing the role of enabling players for activating leverage points in those sectors most impactful on biodiversity. This includes human rights and due diligence across economic value chains.
- Policy mixes, governance (including financing) and decision-making tools for achieving transformative actions for biodiversity, in business and public sectors.
- Exploring solutions to improve the biodiversity impact of retailers in global value chains
- Support processes to ratcheting up the EU biodiversity strategy on transformational changes.

### **Interconnecting biodiversity research and supporting policies**

The establishment of the European Partnership “Rescuing biodiversity to safeguard life on Earth” aims to connect national, local and European research and innovation programmes and combine resources in support of one goal - by 2030 biodiversity in Europe is back on a path of recovery. It will co-develop multidisciplinary research and innovation programmes with stakeholders, set up a European network of harmonised observatories for biodiversity monitoring, and implement a broad range of activities to increase the relevance, impact and visibility of EU research and innovation in tackling the biodiversity crisis in line with the EU Biodiversity Strategy for 2030.

Science-policy interfaces on biodiversity and nature-based solutions have made good progress in the last years<sup>9</sup>, and must be stepped up to achieve targeted impacts on biodiversity-relevant policies, and to get in turn structured policy input into the research cycle. They are also key to guide biodiversity governance, and to implement the EU Green Deal and international

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<sup>9</sup> Good leverage effects have been achieved, notably through EKLIPSE, Oppla, the NBS platform, the EU4IPBES support action 2018-2021.

conventions<sup>10</sup>. In line with the Commission priority 'A stronger Europe in the world', the European Union must take and demonstrate leadership in this field, notably by increasing its support to IPBES<sup>11</sup> -to heave it to the same level as the IPCC-, and to the Convention on Biological Diversity. All topics will directly contribute to the EU Biodiversity Strategy for 2030 and to the Sustainable Development Goals (SDGs) 14, 15, 17.

Specify the main expected impacts for this sub-area:

- Biodiversity research is interconnected across Europe and linked to national and EU policies through a co-funded European partnership.
- Open knowledge and tools generated by research support EU policy needs, notably the EU Biodiversity Strategy for 2030; at the same time, structured input from policies frame the EU research agenda.
- The EU contributes to the international biodiversity agenda and international conventions.

For achieving these impacts, topics are considered addressing the following issues:

- European Co-Funded Partnership “Rescuing Biodiversity to safeguard life on Earth”.
- A mechanism for science to inform implementation, monitoring, review and ratcheting up the new EU biodiversity strategy.
- Support for international research cooperation, in particular for the Convention for Biological Diversity and IPBES.

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<sup>10</sup> In particular, the UN Convention on Biodiversity, and the Sustainable Development Agenda 2030

<sup>11</sup> The Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services

## **Destination 2 – Fair, healthy and environmentally-friendly food systems from primary production to consumption**

The Farm to Fork Strategy, which is at the heart of the Green Deal and key for delivering on the United Nations Sustainable Development Goals (SDGs), aims to enable the transition to fair, healthy as well as climate and environment-friendly and resilient food systems. A shift towards sustainable food systems will bring environmental, health and social benefits, support climate neutrality, offer fair economic gains and ensure that actions leading to the recovery from the COVID-19 crisis puts us onto a sustainable path. R&I are key drivers steering and accelerating the transition to sustainable, healthy and inclusive food systems<sup>12</sup> from primary production to consumption. To unlock the potential of R&I and maximise their impacts, multi-actor approach, involving farmers, food businesses, consumers, and other actors in co-creating innovative systemic solutions in support of food systems sustainability goals, will be promoted. Collectively, the results of the EU funded R&I activities under this Destination will advance knowledge, build capacities and deliver diverse innovative systemic solutions, both technological and non-technological, to speed up the progress towards the objectives set in the Farm to Fork Strategy. The EU also aims to promote a global transition to sustainable food systems in line with the Farm to Fork Strategy and the SDGs. Targeted R&I activities under the EU-Africa Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA) and the EU-China FAB Flagship initiative, will contribute to this ambition.

### Expected impact

The R&I activities implemented under this Destination will set out sound pathways to ensuring food and nutrition security for all within planetary boundaries through knowledge, innovation and digitalisation (see Destination 7) enabling environmentally-friendly, resilient, inclusive, safe and healthy agriculture, fisheries, aquaculture and food systems.

This entails in particular:

- Accelerate transformation of food systems that produce, process and facilitate the shift towards a safe, healthy and environmentally, socially and economically sustainable food and diets
- Enable agriculture that reduces the use and risk of pesticides and antimicrobials, minimises nutrient pollution from fertilisers, decreases pressure on ecosystems and its wide range of services, improves animal welfare and manages natural resources in a sustainable way, while maintaining production at appropriate levels
- Enable sustainable fisheries and aquaculture that minimise the use of chemical inputs, nutrients and antimicrobials and decrease pressure on biodiversity and its wide range of services

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<sup>12</sup> Sustainable food system as defined in the Farm to Fork Strategy and [the Scientific opinion - Sustainable food system](#) (March 2020) informed by *SAPEA Evidence Review Report* (March 2020)

- Ensure quality and safety of products and enhance transparency, traceability and accountability across the food systems and providing easily understandable recommendation for all consumers while also detailed information on all sustainability aspects of foods for the interested citizen
- Promote sustainable food consumption and shift to sustainable healthy diets by improving food environments, ensuring accessibility of healthy and sustainable food for all, increasing the knowledge and awareness about the relevance and utilization of healthy and sustainable food

### **Enabling sustainable farming**

Sustainable farming systems provide a number of economic, environmental and social benefits and are a prerequisite for continued food and nutrition security. They feed into dynamic value chains and manage around 40% of the EU's land and natural resources. The EU's farmers are important stewards of the natural environment and have a significant role in shaping and maintaining rural landscapes, promoting public health, mitigating the effects of climate change and minimising pressure to biodiversity and its wide range of ecosystem services. For farmers, as managers of natural resources and as the backbone of food systems, the Green Deal, and in particular Farm to Fork Strategy, Biodiversity Strategy, Zero Pollution and Climate Action, set ambitious targets. To support the achievement of these targets, R&I activities will enable farmers to manage land, soil, water and nutrients in sustainable ways, achieve climate neutrality and adapt to climate change (Destination 5), reduce their dependency on pesticides, antimicrobials and excess fertilisation, improve animal welfare, maximise the use of the wide range of ecosystem services and reverse biodiversity loss (Destination 1). Thanks to advanced knowledge and diverse innovative solutions, including digital (Destination 7), nature-based (Destination 1 and 5) and social solutions as well as enabling policy and market conditions (Destination 7), farmers will be able to transform their production methods and move to climate- and environmentally-friendly and resilient farming systems that provide consumers with affordable, safe, nutritious, healthy and sustainable food while generating fair economic returns for farmers (Destination 1 and 5). This transition will be supported by unlocking the potential of agroecology, including organic farming, fostering EU-grown plant proteins, making better use of a wide range of ecosystem services and taking also advantage of a mission in the area of "soil health and food". Effective Agricultural Knowledge and Innovation Systems will speed up innovation and the take-up of results needed to achieve the objectives of Farm to Fork Strategy, (Destination 7). Overall, the R&I activities will be instrumental for the European Green Deal, notably with regard to the objectives of the Farm to Fork and Biodiversity Strategies, the Climate Action, and the Zero Pollution Ambition.

The main expected impacts for this sub-area are:

- Foster sustainability and resilience of the farming system that are productive and respond to societal demands, including animal welfare
- Enable sustainable management and efficient use of natural resources, in particular soil, water and nutrients in agriculture

- Increase positive impacts, and decrease negative impacts, of farming on biodiversity and its wide range of ecosystem services
- Reduce environmental footprint of agriculture and improve public health by reducing the use of pesticides, excessive fertilization and the burden of antimicrobial resistance and zoonoses
- Develop integrated approaches to ensure plant and animal health and welfare
- Support development of agro-ecological approaches, including organic farming, and EU plant protein production for food, feed and environmental services
- Support development of policy, market conditions and value chains enabling farmers transition to sustainability

For achieving these impacts, topics are considered addressing the following issues:

- Develop sustainable protein crop systems and value chains and help farmers improve the use of protein crops
- Support the development of diversified farming systems based on agroecological approaches and integrated crop-livestock systems
- Foster networking in organic farming research, increase transparency in organic food systems and reinforce organic food production
- Enhance understanding of the socio-economic drivers, impacts and performance of agroecological approaches
- Develop innovative nature-based solutions<sup>13</sup> to increase resource efficiency in agriculture and for improved plant nutrition, pollution reduction, water availability and soil health
- Develop increased understanding of the environmental impacts of nutrients from agricultural origin, and measures to monitor and prevent excess application of nutrients
- Enhancing capacities to prevent, monitor and control plant pests and diseases including emerging risks
- Foster the development of prevention measures as well as safe and environmentally friendly methods for plant protection and weed control that substantially reduce the use of chemical pesticides, including through the implementation of agro-ecological approaches, multi-cropping and sustainable soil management techniques

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<sup>13</sup> Nature-based solutions are “inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions. Hence, nature-based solutions must benefit biodiversity and support the delivery of a range of ecosystem services.”

- Understand the ecology of infectious animal diseases and foster measures to prevent and treat infectious animal diseases: biosecurity; vaccines and diagnostics for priority animal diseases; improve control of animal parasites and address antiparasitic drug resistance;
- Improve bee and wild pollinators health
- Develop technologies to support livestock management and animal husbandry systems that reduce environmental footprint and promote animal health and welfare in an integrated way
- Improve animal welfare by better understanding animal welfare needs, rethinking animal welfare standards and improving animal welfare communication
- Support diversification of livestock systems: strategies and tools for a sustainable transition
- Support networking and coordination of research on sustainable livestock systems, including at international level
- Assess and improve labour conditions and health and safety at work in farming
- Assess food losses at the production stage and explore ways of preventing them
- Understand of vulnerabilities and designing ways for enhancing resilience of the European food supply to various shocks and stresses such as the COVID-19 pandemic
- Analyse to better understand farmer's behaviour and the environment within farmers have to operate to uncover farmers' lock-ins and levers for moving to sustainable production systems
- Support development of the Farm Sustainability Data Network, to better understand differences in environmental performance of farms, and to support targeted advice based on benchmarking
- Develop innovative tools and methods to support design, monitoring and implementation of CAP Strategic Plans
- Improve sustainability assessment, develop indicators and metrics allowing multi-criteria analysis (beyond LCA) for agriculture systems, agri-food products and food systems considering environmental and social footprints as well as health aspects
- Support design of food sustainability labelling and trustful, cost-effective certification systems,
- develop and demonstrate innovative approaches to reconnect producers, consumers and nature

- Improve governance of the agri-food markets by providing data and tools to enable internalisation of externalities in the price of food, investigating power relations and reducing information asymmetry
- Understand of vulnerabilities and designing ways for enhancing resilience of the European food supply

### **Enabling sustainable fisheries and aquaculture**

Aquaculture and fisheries contribute directly to sustainable, inclusive, safe and healthy food production through the provision of high nutritional value proteins, lipids and micronutrients for a healthy diet. However, ocean-derived food provides on average only 2% of the daily per capita calorie intake and 15% of protein intake in the world. Sustainably produced ocean-derived food can and should account for a much bigger proportion of overall food consumed. It is not only very healthy in general, but, in some areas of the world, essential to fighting hunger and malnutrition. At the same time, many stocks are at present subject to overfishing, including at levels above the estimated maximum sustainable yield, exacerbated by pressures on the oceans from sea use change, habitat destruction, climate change and acidification, pollution and invasive alien species. R&I will deliver inclusive and diversified approaches to allow adapting fisheries management to the different realities including in the international context. Sustainable and resilient aquaculture systems, including of low trophic levels, will increase seafood production, including alternative sources of protein. Seafood security will benefit from the drastic reduction in the currently massive pre- and post-harvest losses in seafood biomass with more selective fishing and more suitable processing, transport, consumption, valorisation and disposal. Fishers and consumers awareness and behaviour towards responsible production, consumption and disposal of seafood, will contribute directly to more balanced development of vibrant coastal areas. An overarching partnership “A climate neutral, sustainable and productive Blue Economy” will contribute to increased food security, create value added, blue growth and jobs in Europe through a jointly supported research and innovation programme in the European seas, coastal and inland waters.

The main expected impacts for this sub-area are:

- Raise citizens awareness and trust on seafood responsible and sustainable consumption.
- Ensure sustainable increase of aquatic biomass production and diversification of seafood products for a fair, healthy and environmentally-friendly food system
- Contribute to circularity and zero waste of the seafood production system and therefore significantly reduce the pressure on the environment

For achieving these impacts, topics are considered addressing the following issues:

- Enhance traceability of seafood – towards fully transparent seafood products in Europe
- Foster biosecurity, disease prevention and fish welfare in aquaculture production

- Develop integrated and sustainable freshwater bioeconomy
- Boost innovatively produced sustainable food from the oceans and fresh water bodies
- Minimise waste of fish and shellfish biomass and novel processing and packaging technologies
- Foster sea to fork consumer engagement for sustainable seafood consumption

### **Transforming food systems for health, sustainability and inclusion**

To address the challenges that the national, EU and global food systems are facing, a system-wide transformation is required. A shift towards more resilient and environmentally, socially and economically sustainable food systems, sourced from land and sea, is necessary to deliver safe, healthy, accessible and affordable food and diets for all, while respecting planetary boundaries. This implies a better understanding of the interactions between the different components of the current food systems, to foster solutions that maximise co-benefits to four Food 2030 priorities: nutrition and health including food safety; climate and environmental sustainability; circularity and resource efficiency; and innovation and empowerment of communities. To accelerate this transformation a diverse multi-actor and citizen engagement process is needed, within which multiple European and global challenges can be addressed, R&I and R&I policy can be developed, European competitiveness can grow, and innovative solutions – from new products, tools, approaches and technologies to social, governance and institutional innovation, and new business models - can be developed, tested and demonstrated. Advancing knowledge and fostering innovative solutions in support of dietary shifts towards sustainable healthy nutrition, alternative and plant-based proteins, prevention and reduction of food losses and waste, microbiome applications, food safety and traceability, food fraud, behavioural change, personalised nutrition, urban food systems (see Destination 6), food systems governance and systems science, and food systems digitalisation (see Destination 7); the transition to sustainable, healthy and inclusive food systems as set out in the objectives of the Farm to Fork Strategy, will be accelerated.

The main expected impacts for this sub-area are:

- Stimulate dietary shift for sustainable healthy food consumption and promote healthy, diverse, safe, accessible and affordable food provisioning for all people
- Develop further understandings and solutions to how food and nutrition contribute to health and wellbeing.
- Advance understanding of systems science and integrated models for improved decision-support
- Reduce food losses and waste at all levels and parts of the food system

- Anticipate and mitigate emerging food safety risks and build capacity to perform holistic risk assessments and develop improved control measures for biological and chemical hazards across the food system
- Better understand the extent of food fraud and develop means to prevent fraudulent practices
- Develop the potential of the food system microbiomes for healthy people and planet

For achieving these impacts, topics are considered addressing the following issues

- Develop new knowledge on the impact of ‘food environments’ and factors and incentives influencing individual and collective behaviour to foster responsibility amongst food systems actors and empower people to adjust their habits and adopt sustainable healthy dietary choices and behaviours.
- Better understand how food contributes to health by investigating links between food, nutrition, health promotion and disease prevention, including geographical, socio-economic and environmental aspects, and to reduce the incidence and progression of Non Communicable Disease, and other diet-related illnesses.
- Improve and diversify the availability and consumption of alternative proteins (ie: plant-based, algae, insects, lab-grown meat), explore the potential of food environments to foster dietary shift, and fill the knowledge gaps on nutritional/health, safety, allergenicity and environmental assessment of alternative protein rich diets and plant-based dietary shifts.
- Change social norms for effective food waste prevention and reduction amongst all food systems sectors and actors, including citizens
- Support the harmonization of food waste and food loss measurement and monitoring methodologies
- Develop and validate models and approaches for performing risk-benefit and cost-benefit assessments integrating and balancing the environmental, social/economic and health aspects across the food system, relevant to and including key sectors like food processing, transport and retailing, and the food service sector (HORECA).
- Develop improved methods and tools to help perform holistic risk assessments to support food systems regulatory science; and develop technologies, tools and methods to identify, evaluate, and reduce risks from chemical and microbiological hazards throughout the food system.
- Better understand the extent of food fraud and develop means to prevent fraudulent practices by improving traceability and safeguarding authenticity, understanding drivers and fostering solutions for fraud prevention

- Increase understanding and develop microbiome-related solutions to improve planetary health and food ingredients to foster better health and food safety

### **International cooperation: EU-Africa FNSSA and China FAB**

#### *EU-Africa Partnership on Food and Nutrition Security and Sustainable Agriculture (FNSSA)*

Assuring global food and nutrition security is recognised as major goal in the development of scientific co-operation EU - Africa for which Africa can play a major political role. Since April 2016 the Roadmap towards a jointly funded EU-Africa research and innovation partnership on Food and Nutrition Security and Sustainable Agriculture (HLPD FNSSA) brings together the S&T representatives from the 27 EU MS and the 55 African Union (AU) MS. It outlines an implementation pathway as well as priorities for the jointly developed research and innovation agenda. The process is co-owned and co-funded by the EU (Horizon 2020 and Pan African instrument), the AU Commission and several AU and EU MS, including associated countries. Recognising the current and future challenges of African and European food systems, such as climate change, pest outbreaks or exceptional situations such as COVID-19, calls for a joint Africa – Europe action under the HLPD FNSSA to transform agricultural and food systems and provide greater resilience against threats, lessen its expected impacts and bring added-value to the joint action.

Specify the main expected impacts for this sub-area:

- Contribute to SDG2 by 2030, end hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Contribute to the international dimension of the Farm to Fork Strategy: through R&I scale-up up food systems approaches that are working for all people and the planet

For achieving these impacts, topics are considered addressing the following issues:

- Improve food system governance in crisis situations – food security and mapping: develop innovative methodologies/models to improve risk scenarios, including the resilience of food in cities with special regard to vulnerable population groups and support innovative small food start-ups.
- Embrace digital technologies in the whole agri-food value chain, easing the governance of the agri-food systems and supporting food actors to anticipate and assess potential food crises also by using environmental and Earth observation.
- Implement agro-ecological approaches to alleviate pressure of agri-food production on natural ecosystems, contributing to agri-food systems resilience and facilitating nature-based responses to current and future food risks.
- Implement ‘One Health approach’ for plant and animal health, based on a systemic perspective linking the health of ecosystems, animals and humans, contributing to prevent the emergence and spread of pest and diseases with nature-based solutions.

### *EU-China Food, Agriculture and Biotechnologies (FAB) Flagship initiative*

Research and innovation in the field of Food, Agriculture and Biotechnology (FAB) has been identified as a key priority for the EU – China cooperation, with a dedicated EU - China Task Force on FAB established in 2013. Being the two biggest food producers in the world, China and the EU share a common goal to join forces to support the global transition to sustainable agri-food systems. Ensuring sustainable agri-food systems will also increase global trade predictability, overall productivity, transparency of the food chain and resource-efficiency. Research and innovation cooperation in FAB can make a major contribution to these important common and global challenges. EU-China FAB cooperation will focus on sustainable forestry and agricultural practices, in particular those that increase production while reducing GHG emissions and with the objective of enriching and conserving carbon in soils that can play a role as a potential source of negative emissions.

Specify the main expected impacts for this sub-area:

- Jointly tackle climate change and environmental-related challenges and meet the objectives of the Paris Agreement on climate change, and contribute to the Sustainable Development Goals
- Support the global transition to sustainable agri-food systems, in line with the objectives of the Farm to Fork Strategy

For achieving these impacts, EU-China FAB topics are considered addressing the following issues:

- Improve understanding of agricultural systems and their impact on ecosystem services and the environment
- Build resilience of forests to changing climate
- Optimize the production of primary resources and improve the valorisation of waste streams for small and medium scale solutions
- Foster sustainable food production, consumption and trade

### **Destination 3 – Circular economy and bioeconomy sectors**

This destination targets the climate-neutral circular and bioeconomy transitions, covering integrated circular solutions at territorial and sectoral levels, for important material flows and product value chains, as well as key bioeconomy sectors such as sustainable bio-based systems, sustainable forestry, small-scale rural bio-based solutions, and aquatic value chains.

Circularity aims at extending the lifetime and retaining the value of products and materials, supports a sharing, reusing, and material-efficient economy, and minimises the non-sustainable use of natural resources. The safe and sustainable use of biomass and waste for the production of materials and products, including nutrients, has the potential to reduce the EU's dependence on non-renewable resources, cut GHG emissions, offer long-term circular carbon sinks and substitutes to carbon-intensive products, and reduce pressures on biodiversity and its wide range of ecosystem services. The potential of biological resources goes beyond biomass processing into renewable products. It includes the use of organisms and their parts in green industrial processes. Marine and land-based biotechnology can provide new sustainable and safe food and feed production methods, greener industrial products and processes, new health-related products, and can help characterise, monitor and sustain the health of marine and terrestrial ecosystems. The potential of marine resources and biotechnology will contribute to the coming “blue economy”, which accelerates the transition towards a climate-neutral economy that is sustainable and inclusive. The concepts of the circular economy, bioeconomy and blue economy provide an opportunity to balance environmental, social and economic goals.

A local and regional focus is crucial for a circular economy and bioeconomy that is sustainable, regenerative, inclusive and just. Urban and regional solutions can create jobs and help our economies rebound from the COVID-19 crisis. Circular water use prevents pollution and increases resource efficiency at different scales. It also presents a tremendous opportunity for businesses, utilities and local authorities to create greater value from water systems and cover the cost of environmental protection, and to minimise the impacts of water extraction on ecosystems.

#### Expected impacts

Proposals for topics under this Destination should set out a credible pathway to contributing to the following expected impacts:

- Contribute to the transition towards a sustainable, regenerative, inclusive and just circular economy and bioeconomy at local and regional scale.
- Contribute to the departure from a non-renewable, fossil-based economy through the sustainable use of waste and biomass from land and sea for sustainable, high-value materials and products, with a lower environmental impact.
- Contribute to halting the biodiversity decline and to restoration of ecosystems, through specific initiatives and introducing more sustainable practices into the bioeconomy sectors.

- Reduce greenhouse gas emissions from primary material and waste management. GHG-neutral and climate-proof production and consumption will be enabled.
- Increase resource efficiency along value chains, from production to consumption, disposal and treatment. The resource-efficient management and sustainable use of biological and renewable resources will result in extended product and material lifetimes, new non-toxic use forms, increased added value along the whole value chains, higher competitiveness as well as more attractive jobs in rural, coastal, peri-urban and urban areas.
- Establish circular and bio-based systems based on sustainability, inclusiveness, health and safety.
- Reduce the use of primary non-renewable raw materials and contribute to the EU's resource independence.
- Capitalise on the potential of marine biological resources and biotechnology, to deliver greener industrial products and processes and contribute to the circularity of the food system by characterising, monitoring and sustaining the health of marine ecosystems.

### **Enabling a circular economy transition**

A systemic and science-based circular transition with the help of research, innovation and investments will address all issues from material selection and product design via resource efficiency along the value chain to an optimised after-use system, incorporating reuse, repair and upgrade, refurbishment, remanufacturing, collection, sorting and new forms of recycling. It will tackle all barriers and mobilise all key stakeholders. The development of definitions, taxonomies, indicators and targets will inform policy and decision making. Improved life cycle methods, data and information will enable economic actors, including consumers, to make sustainable choices. The development and deployment of specific technological and non-technological circular solutions, including new business models, will cover intra- and inter-value chain collaboration and broaden the existing market interaction. The Circular Cities and Regions Initiative (CCRI) under the European Circular Economy Action Plan will expand the circular economy concept beyond traditional resource recovery in waste and water sectors and support the implementation, demonstration and replication of circular solutions for the transition towards a sustainable, regenerative, inclusive and just circular economy at local and regional scale. Water use will be tackled from a circularity perspective, aiming at pollution prevention, resource efficiency and business opportunities. Valorisation of secondary raw materials will allow the uptake of recovered and recycled nitrogen and phosphorus from urban and industrial waste water and sewage sludge. Bio-waste, biological residues and side streams, digestate and treated manure will serve as valuable input materials for fertilising products.

Specify the main expected impacts for this sub-area:

- A significant contribution to climate neutrality through the reduction of GHG emissions from sourcing, use and wastage of primary resources, provision of carbon sinks through circular bio-based products, while safeguarding biodiversity
- An enhanced knowledge base for policy makers to design, implement and monitor policies and instruments for a circular transition
- Increased technical, financial and legal expertise of policy-makers and project promoters on circular solutions at local and regional scale
- Systemic insight into the opportunities, challenges and instruments of circularity e.g. regarding value chains, retailer responsibility or consumer behaviour
- A significantly higher level of involvement of all actors (manufacturers, retailers, consumers, public administration etc.) in circular practices under specific demonstration conditions
- Increased recycling rates and a higher uptake of secondary materials, and measurable increase in circular business practices, in particular in the uptake of repair and reuse, and in the real lifetime of products
- Reduced impact of human activities on natural water resources by minimising wastewater and its negative effects, maximising resource and energy recovery, creating value from water systems and covering the cost of environmental protection
- A boost for the European water market as well as for the global competitiveness of the European water industries
- Demonstration of the potential of fertiliser production from secondary raw materials to cover 50% of the fertiliser market by 2030

For achieving these impacts, topics are considered addressing the following issues:

- Development of a European circular economy dataspace concept and demonstration of its feasibility on selected value chains
- Development and support of a publicly available, comprehensive life cycle database of sustainable products.
- Setup of collaborative partnerships and networks to develop innovative circular economy solutions
- Demonstration and deployment of technologies and designs for increased quality and durability of secondary materials and increased ratio of secondary materials in new climate-neutral circular products

- Demonstration and deployment of solutions that prevent waste, e.g. through design and use models, expand the lifetime and improve the life cycle performance of circular products and materials, and improve the quality of and the trust in recycled material
- Demonstration projects and support schemes for the implementation, demonstration and replication of circular solutions at local and regional scale
- Building technical, financial and legal expertise of local and regional policy-makers and project promoters in implementing, demonstrating and assessing circular solutions (including circular bioeconomy/bio-based solutions)
- Support for TRL upgrade of local and regional circular economy value chains, processes and technologies
- Support for stakeholder cooperation to facilitate the replication of circular solutions at local and regional scale
- Indicators and methods for measuring transition, its benefits, challenges and trade-offs
- Circular value chain analysis focusing on intra- and inter-value chain collaboration
- Identification and analysis of instruments to trigger changes in consumers, producers and retailers' behaviours
- Increasing the circularity in textiles and plastics, including bio-based ones, electronics and construction
- Integrated solutions for circularity in the construction, buildings sector and of the clean energy sector
- Innovative solutions to over-packaging, single use plastics, and microplastic pollution
- New circular solutions and decentralised approaches in the water sector, carbon neutral water systems, innovative strategies and solutions
- Alternative water sources, targeting vulnerability and resilience of European water infrastructures
- Integration between grey and green infrastructures in rural, urban and coastal areas
- Smart water distribution and collection networks
- Market stimulation for safe alternative fertilising products from secondary raw materials, including bio-based ones

### **Innovating sustainable bio-based systems and the bioeconomy**

Bio-based innovation lays the foundations for the transition away from a fossil-based carbon-intensive economy by encompassing the sustainable sourcing, industrial and small scale

processing and conversion of biomass from land and sea into circular bio-based materials and products with reduced carbon and ecological footprint including lower impacts on biodiversity. It also capitalises on the potential of living resources, life sciences and industrial biotechnology for new discoveries, products, services and processes. Digitalisation will enable prospecting, understanding and deployment of efficient and sustainable bio-based systems. Bio-based innovation can bring new economic activities and employment to regions and cities in the recovery from COVID-19, contribute to revitalising rural and coastal economies and strengthen the long-term circularity of the bioeconomy, including through small non-food bio-based solutions. Furthermore, targeted investments can contribute to increasing and diversifying the income of primary producers.

Enabling sustainable bio-based systems will contribute to building a climate-neutral, circular, environment-friendly and inclusive economy in full compliance with the European Green Deal, focusing notably on Industrial Strategy, Circular Economy Action Plan, EU Bioeconomy Strategy, Biodiversity Strategy, Farm to Fork Strategy and the EU Forest Strategy. Environmental objectives and climate neutrality will build on a robust understanding of environmental impacts and trade-offs of bio-based systems at the European and regional scale, including the effects of global trade from primary resources to products and processes as well as comparisons to similar aspects on the fossil and carbon-intensive counterparts. Systemic impacts of bio-based systems on biodiversity and its wide range of ecosystem services as well as how we restore and use them, need to be assessed, and negative ones avoided in line with the “do no harm” principle of the European Green Deal. Implementing sustainable and just bio-based value chain requires symbiosis across primary production and “industrial ecosystems” in regions and Member States and improved environmental performance of products, processes and services along value chains and life cycles. A just transition to a circular and sustainable bioeconomy will be enabled by integrating primary production, technical solutions, legal and financial advisory services, knowledge sharing and policy making at local level, including supporting the implementation of the Circular Cities and Regions Initiative (CCRI).

Specify the main expected impacts for this sub-area:

- contribute to reach climate neutrality in Europe
- preserve natural resources and safeguard or enhance biodiversity and its wide range of ecosystem services in primary production contributing to high-value added applications
- addressing competition for sustainable biological feedstock for different uses
- deploying sustainable multiscale and zero-waste innovative biorefineries for climate-neutral circular products
- demonstrate and replicate circular and sustainable bio-based solutions at local and regional scale
- deploying sustainable and just value chains in the bio-based sectors, demonstrating industrial symbiosis across production sectors

- optimizing the use of biological feedstock in “industrial systems”
- increasing the carbon sequestration capacity of the bio-based sectors, providing circular bio-based products as carbon sinks and helping to substitute fossil and carbon-intensive ones whilst decreasing the impacts on biodiversity and its wide range of ecosystem services
- enhanced functional and environmental performance of circular bio-based products
- exploiting the potential of life sciences and biotechnology for a healthy planet and people
- enabling the adaptation of ecosystems to climate change using biomolecular discoveries
- digitalizing bio-based sectors
- Development and demonstration of small-scale bio-based solutions for primary producers and SMEs in rural areas whilst decreasing their impacts on biodiversity and its wide range of ecosystem services

For achieving these impacts, topics are considered addressing the following issues:

- assessment and improvement of the climate change mitigation potential of circular bio-based systems;
- simultaneous sustainable management of ecosystems, climate change mitigation and adaptation, biodiversity protection and enhancement in efficient primary production for high-value applications
- broadening the options for sustainable biomass provision, beyond agricultural and forest resources
- assessment of environmental sustainability, certification and traceability of biological feedstock
- radically increasing the efficiency, sustainability and effectiveness of processes converting biological resources
- resource efficiency of production chains in biorefineries, including via cascading use of biomass
- enabling the use of industrial waste and side-stream valorisation through industrial symbiosis and governance innovation whilst decreasing its impact on biodiversity and its wide range of services
- developing and upgrading biodegradable materials for specific applications and end-of-life environments

- supporting demonstration projects and introducing support schemes for the implementation, demonstration and replication of circular bioeconomy solutions at local and regional scale
- increasing the technical, legal and financial expertise of policy-makers and innovation support services for the implementation of circular economy solutions at local and regional scale
- optimisation of bio-based product design and processing and increased end-of-life options (reuse, repair, remanufacturing and recycling patterns)
- improving the performance of bio-based materials and products, including longer-term uses allowing carbon storage and other functional performances and through the replacement of toxic substances and materials in industrial processes with safe bio-based ones
- safe use of organic side and waste streams from agriculture, forestry, fishery, aquaculture, as feedstock for bio-based sectors whilst decreasing their impact on biodiversity and its wide range of services
- develop industrial symbiosis and circularity of bio-based industrial ecosystems through technological, systemic, social and business model innovation and across bio-based and non-bio-based sectors
- developing innovative bio-based additives that enhance the recyclability of any materials;
- digital tools, sensors and methodologies for improved efficiency and sustainability of industrial processes in the bio-based sectors;
- enabling the capture and use of CO<sub>2</sub> from emissions of bio-based processing as feedstock for the production of valuable chemicals, materials and products
- Enabling sustainable production via biotechnology approaches of novel bio-based applications, biopharmaceuticals and de novo production of biomolecules using nature's "biological assets" which are assessed on their systemic impact on biodiversity and ecosystem services, and in full respect of the Cartagena and Nagoya protocols
- development of competitive, sustainable and novel industrial processes with improved environmental services and consumer products through the application of biotechnologies across bio-based value chains and materials
- enabling the application of digital tools for improved prospecting, understanding and deployment as well as more efficient and sustainable use of biological resources and industrial bio-based operations

- understanding the structure, functions and mechanisms of microbiomes as related to the bio-based innovation (products and services)
- development of improved bio-based systems and novel bio-based sensors
- development of new production of (bio-) organisms for vaccine manufacturing, and “pharming” of optimised crop plants, animals
- analysing the potential benefits/opportunities and challenges/concerns of new genomic techniques applied in microorganisms, plants and animals for the agri-food, industrial and medical sectors.
- Biotechnological approaches with molecular discoveries addressing the climate emergency combining the zero pollution challenge with industrial production
- prospecting, understanding and sustainably using biological resources based on their convergence with digital technologies
- Scaling-up small-scale non-food biobased solutions and development of technologies adapted to rural conditions
- enhanced cooperation between research, advisory services, farmers and other actors in the supply chain building technical, financial and legal expertise of local and regional policy-makers and innovation support services in implementing, demonstrating and assessing circular bioeconomy solutions

### **Safeguarding the multiple functions of EU forests**

The multifunctional management of European forests and the use of timber as a sustainable raw material have a crucial role to play in the achievement of the EU’s climate and energy policies, the transition to a circular and sustainable bioeconomy as well as the preservation of biodiversity and the provision of ecosystem services such as recreation, clean air and erosion control among many others. Further, forestry and the forest-based sector offer important opportunities for wealth and job creation in rural, peripheral and urban areas.

Despite the recognition of their multifunctionality, and the progress made in defining and implementing their sustainable management, the good condition of European forests is increasingly threatened by a growing number of social, economic and above all environmental and climatic pressures. The European Green Deal communication and the new EU Biodiversity Strategy recognise that the EU’s forested area needs to improve, both in quality and quantity, for the EU to reach climate neutrality and a healthy environment.

Specify the main expected impacts for this sub-area:

- Unlocking the potential of EU forests for public and private goods
- Optimising forest management under a changing climate

- Preserving biodiversity and forest conservation

For achieving these impacts, topics are considered addressing the following issues:

- Efficient and sustainable biomass production for a circular and sustainable bioeconomy, exploring new and innovative uses of wood to substitute fossil-based materials whilst improving biodiversity and the wide range of ecosystem services
- Use of digital solutions and development of new value chains to maximise the multiple benefits of forests for the EU society
- Optimising climate change mitigation and adaptation measurements, including their interlinkages with biodiversity loss and restoration
- Better understanding of the relationship between biodiversity and other ecosystem functions and climate change

### **Innovating for blue bioeconomy and biotechnology value chains**

Marine biological resources and blue biotechnology are crucial to delivering on the Green Deal's ambition of a 'blue economy' which alleviates the multiple demands on the EU's land resources and tackles climate change.

The immense marine biodiversity holds responses to challenges - climate, biodiversity loss, pollution, food security, green products, and health but remains largely unexplored. Unprecedented advances in the biotechnology toolbox (e.g. -omics, bioinformatics, synthetic biology) have triggered an increased interest in the potential of marine bioresources. Marine biotechnology will be key to unlocking the value of marine biological resources by decoding the ocean's DNA and learning from the function and processes of marine living organisms, whilst assessing and avoiding systemic impacts on biodiversity, their wide range of services, and how we protect and restore them.

Innovative marine bio-based products will be developed in sectors such as pharma, food supplements, nutraceuticals, cosmetics, polymers, etc. New marine-derived enzymes can support green industrial bioprocessing (e.g. chemicals, leather, textiles) and be used to degrade persistent pollutants. Expanding the use of materials discarded during harvesting, cultivation and processing of marine species, as a source of e.g. proteins, lipids and biochemical, also provides opportunities. Such potential needs to be systemically assessed on its impacts on biodiversity and its wide range of services, and the way we restore and use them. Omics tools will provide new insights into marine ecosystem functioning and monitoring.

Specify the main expected impacts for this sub-area:

- Unlock the potential of marine biological resources to accelerate the transition towards a climate-neutral, circular, green and inclusive economy.

- Capitalise on the advances of marine biotechnology to deliver greener industrial products and processes, and help to characterise, monitor and sustain the health of marine ecosystems.

For achieving these impacts, topics are considered addressing the following issues:

- Advance the exploration of marine biodiversity and bioprospecting for the discovery of natural products whilst assessing and avoiding impacts on biodiversity and its wide range of services
- Culturing and production of aquatic biomass for bioactive and added-value products and sustainable and circular processing
- Sustainably unlock the potential of algae for innovative blue bioeconomy products and circular food systems
- Unlock the potential for a microbiome-based blue bioeconomy leading to sustainable production systems, biological discoveries, and healthy marine ecosystems

## Destination 4 – Clean environment and zero pollution

Anthropogenic pollution undermines the integrity of Earth ecosystems and severely affects natural resources essential for human life. Destination 4 seeks to halt and prevent pollution, by focussing the first Work Programme on addressing issues concerning fresh and marine waters, nutrients as well as the environmental performance of processes, thereby contributing to the EU Green Deal, its Zero-pollution ambition, Farm to Fork Strategy, EU Biodiversity Strategy and the 2030 Agenda for Sustainable Development.

Specific R&I actions on water will be aimed at preserving, restoring and monitoring freshwater quality and developing prevention and mitigation strategies designed to eliminate known and unknown pollutants, which is crucial for human activities, while halting biodiversity decline and protecting ecosystems. These actions will be implemented in cooperation with the proposed co-funded partnership “Water4All: Water security for the planet”. Nutrient actions will contribute to these goals by reducing excessive nitrogen and phosphorus (N/P) flows, mainly due to the over-use of fertilisers, and bringing them back within safe ecological planetary boundaries. In marine waters, where the impacts of pollution and other stresses are visible at all scales, actions will tackle the combined effects of multiple stresses with a view to restoring clean and healthy seas and oceans in the EU. Finally, bio-based innovation action, including biotechnology, has the potential to accelerate the transition from a fossil-based to a resource-efficient and zero-pollution circular, blue and bio-economy by tracing, assessing and reducing environmental impacts of bio-based value chains.

### Expected impact

Proposals for topics under this Destination should set out a credible pathway to contributing to the following expected impacts:

- Providing science-based evidence and solutions enabling a better assessment of pollution threats to air, water and soil, pathways as well as improved monitoring, control and mitigation of harmful pollutants
- Protecting and restoring the qualitative status of EU waters (both fresh and marine), as a direct contribution to reverse the decline of aquatic biodiversity, and to support the implementation of relevant EU legislation and initiatives
- Enhancing and deploying an internationally competitive EU water industry
- Restoring anthropogenic N/P flows within safe ecological boundaries at European and regional scale<sup>14</sup>
- Reducing nutrient losses by at least 50% and, subsequently, the use of conventional fertilisers by at least 20% by 2030, as envisaged by the European Green Deal

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<sup>14</sup> Based on, i.a., the Planetary Boundaries concept by Johan Rockström and the EEA/FOEN report “Is Europe living within the limits of our planet”

- Contributing to reducing the main negative impacts of pollution in the loss of marine biodiversity and ecosystem services
- Contributing to achieving a 'good condition' of EU seas by 2030 through pollution prevention, reduction and removal on the marine ecosystems and to implementing the new EU Biodiversity Strategy to 2030 targets to protect 30 % of Europe's seas and 10 % under 'strict protection'
- Achieving clean European seas through the transition needed – behavioural, social-economic, demographic, governance – to address and manage marine pollution and green blue transition.
- Enabling zero-pollution circular and bio-based value chains, including via biotechnology solutions, for environmental protection, restoration and monitoring
- Tracing environmental sustainability of bio-based value chains within Europe and across borders

### **Halting emissions of pollutants to soils and waters**

Diffuse pollution from land and urban sources is still a major stressor of aquatic ecosystems, threatening the quality of surface waters and aquifers, and finally affecting all water-dependent sectors. Projected impacts of climate change will alter, and notably reduce, the hydrological flows in many parts of Europe, while eutrophication could be enhanced by increasing temperatures. Climate change and increasing water demand will exert significant pressures on groundwater quality<sup>15</sup>, notably where the combined effect of water table depletion and sea level rise will endanger the integrity of coastal aquifers and groundwater quality due to saline water intrusion or extreme events (e.g. higher tides, storm surges or inland flooding events), will put at risk coastal wetlands and reservoirs, estuaries and ecosystems. Originated mostly from run-off and land erosion, sediments are likely the major source of physical pollution of water bodies (excessive turbidity, impacts of deposition, accumulation of litter and debris) and contributes largely to chemical and biological pollution of receiving waters. Beside land use practises, the increasing intensity and variability of precipitations will affect the deposition and transport of sediments and can lead to a remobilisation of legacy contaminants and further deteriorate the quality of water bodies, including aquifers, estuaries and coastal areas, and of their ecosystem functionalities and services.

Nitrogen and phosphorus flows from anthropogenic sources, mostly from excessive fertiliser or inefficient input in agriculture, exceed planetary boundaries. Leaching and run-off negatively affect soil biodiversity, pH levels, organic matter content and carbon sequestration capacity, and cause water bodies to eutrophy. Ammonia and nitrous oxide emissions to air impact air quality and climate. As all environmental media are concerned, a systemic and integrated approach considering different N/P sources and regional conditions (geography, climate zones,

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<sup>15</sup> Member States identified that diffuse pollution is still a significant pressure that affects 35 % of the area of groundwater bodies, while quality standards (pesticides, herbicides...) were exceeded in 15 % of the groundwater bodies

economy activities, soil properties, eco-system condition, agricultural practices, governance structures etc.) is necessary to bring N/P flows back within safe ecological boundaries. To this end, an N/P flows approach that determines region-specific N/P target loads as well as demonstration actions of best region-specific agricultural, economic and governance practices will help address the issue.

Specify the main expected impacts for this sub-area:

- Advancing knowledge and understanding of diffuse pollution sources under global and climate changing conditions that enable the development and deployment of solutions to protect water quality.
- Preserving the quality of groundwater and coastal aquifers by anticipating measures against threats posed notably by global and climate change.
- Providing knowledge and approaches to protect water bodies from contamination originated by sediments and legacy pollution.
- Pursuing the zero pollution of ecosystems by limiting N/P emissions into soils and water bodies, halting N emissions into the air to bring N/P flows back within safe ecological boundaries
- Mainstreaming the use of safe carbon-based organic fertilisers, recovered from (bio-) waste, to replace the production and application of conventional fertilisers
- Establishing dynamic interfaces and fully exploiting synergies between rural/coastal and urban environments with regard to limiting N/P emissions

For achieving these impacts, topics are considered addressing the following issues:

- To assess sources, transport and impacts of diffuse pollution at catchment level.
- To elaborate diffuse pollution indicators, models and scenarios enabling sound based decisions at basin scale.
- To develop adapted pollution abatement strategies and solutions to prevent and reduce negative impacts of non-point source pollution on water bodies, including coastal areas.
- To understand the synergistic effects of multiple stressors on groundwater quality in view to better evaluate the impacts of global and climate change, particularly in highly vulnerable coastal areas.
- To assess possible options and propose measures to reduce negative effects of climate change and develop strategies and deploy solutions to mitigate the impacts of global change on groundwater quality.

- To enhance the understanding and assessment of threats posed by sediments and accumulated legacy pollution to water bodies in a global and climate context to develop adaptive indicators, models, tools and scenarios leading to possible interventions.
- To develop and deploy novel measures preventing sediments' pollution, as well as innovative strategies and cost-effective remediation solutions addressing legacy pollution.
- Identifying safe ecological boundaries of nitrogen and phosphorus flows at regional/river basin level and corresponding reduction load targets
- Understanding nutrient flows in water and soil, i.e. the nitrogen cycle as well as the dynamics of phosphorus in the soil matrix, and its regional variation across the EU
- Assessing environmental impacts of fertilising products recovered from secondary raw materials.
- Stimulating agro-ecology and nature-based solutions to re-balance N/P flows and minimise pollution of soils and water bodies.
- Encouraging the use of safe carbon-based fertiliser alternatives, recovered from biowaste, to replace conventional fertilisers.

### **Protecting drinking water and managing urban water pollution**

Water pollution originated in increasingly dense urban areas requires to develop innovative and holistic approaches at city/catchment level to ensure global and climate resilient water quality by considering different spatial and temporal scales and contexts, as well as pollution derived from point, non-point source and extreme weather events. Contaminants of emerging concern (CECs) in water bodies may cause ecological or human health impacts, and typically are not well regulated under existing environmental legislation. Sources of these pollutants include industry, agriculture, urban runoff, household products, coatings, paints and pharmaceuticals that are disposed to sewage treatment plants and subsequently discharged to water bodies. Micropollutants, pathogens and CECs, individually or combined, represent as well a concern for a safe drinking water supply. Increasing water temperatures due to climate change could deteriorate the quality of drinking water sources by favouring the conditions for enhanced eutrophication as well as pathogens development or invasive species spreading. Emerging concerns are also raising at the level of drinking water treatment and distribution, notably in relation with disinfection operations and possible harmful effects of by-products and metabolites.

Specify the main expected impacts for this sub-area:

- Preserving water bodies from urban pollution and further enhance its quality for save human use and healthy ecosystems by developing advanced and resilient urban water systems.

- Enhancing the EU scientific and technological basis enabling the assessment, monitoring, control and mitigation of CECs.
- Protecting drinking water sources preparation and supply, including real-time monitoring and early warning systems.
- Fostering the EU position and role in the global water scene through advanced knowledge, breakthrough solutions and innovative technologies, as well as measures and evidences for policy-making and implementation.

For achieving these impacts, topics are considered addressing the following issues:

- To prevent urban water pollution at source and control measures, improved real-time monitoring and advanced treatment and disposal, which could include the development of breakthrough concepts and the next generation of WWT technologies.
- To develop new strategies to prevent and manage urban water pollution from networks leakages, combined sewers overflows (CSOs) and urban drainage by combining advantages from blue-green solutions and decentralised approaches.
- To assess the sources, transport, occurrence and impacts of CECs, including advanced analytical methods and new sensors for control and monitoring.
- To develop risk management approaches and decision supporting tools considering exposure of CECs, and derived mixtures and metabolites, on human and aquatic ecosystems health.
- To develop new strategies and deploy innovative solutions for preventing and removal of CECs.
- To expand the knowledge base required to better assess pollution threats (pathogens, toxins, algal blooms, PFAs, DBPs, contact materials...) and the combined effects of multiple stressors on water sources to protect drinking water preparation and supply.
- To develop and deploy enhanced systems monitoring drinking water sources, adequate treatment methods and innovative and cost-efficient disinfection processes.

### **Addressing pollution on seas and oceans**

The European Green Deal (GD) confirms and highlights that the oceans are being polluted and destroyed - the result of the release and subsequent effects of substances or energy in the marine waters. According to a new European Environment Agency (EEA) report, all four regional seas in Europe have a large-scale contamination problem, ranging from 96% of the assessed area in the Baltic Sea and 91% in the Black Sea, to 87% in the Mediterranean and 75% in the North-East Atlantic Ocean. Main sources of pollution include industrial, agricultural, municipal waste runoff, other human activities (e.g. transport), underwater noise, light, atmospheric deposition, etc. into marine waters.

Specify the main expected impacts for this sub-area:

- Contribute to reduction of the main negative impacts of pollution in the loss of marine biodiversity and ecosystem services.
- Contribute to the prevention and removal of pollution at sea by 2030.
- Achieving clean European seas through the transition needed - behavioural, social-economic, demographic, governance - to address and manage marine pollution – blue green transition.

For achieving these impacts, topics are considered addressing the following issues:

- Understand the harmful effects of marine pollutants on the marine ecosystem function, services they provide, and on human health in a multi-stressors approach.
- Contribute to the reduction, mitigation and removal of pollution of marine waters by developing technologies/innovative solutions to address main marine pollution types, main sources and steadily reduce their leakages to the oceans, including smart teleoperated or autonomous drones/robotics solutions, underwater Internet-of-things and intelligent sensors as well as effective marine pollution removal technologies (e.g. ships) and methods (e.g. fishing for litter), and testing the effectiveness of nature-based solutions under pollution and for pollution removal.
- Reach the policy vision of achieving clean European seas through a profound transition on how we address marine pollution – blue green transition.

### **Increasing environmental performances and sustainability of processes and products**

Environmental pollution resulting from human activity are detrimental to ecosystems at different functional levels, representing an important economic burden for society. Circular bio-based systems have the potential to prevent and restore impacts on ecosystems provide they are developed sustainably and systemically aiming at mitigating the climate change and its impacts, increasing resources efficiency and circularity, preserving and restoring ecosystems services, natural resources, air/water/soil quality and biodiversity. Indicators of such sustainability are needed, building on dynamic perspectives at scales ranging, in space, from planetary to local ecosystems and, in time, from next decade to end of century and beyond. Moreover, impacts should be traced along value chains and trades to enable responsible production and consumption.

Bioremediation using microbes is a sustainable, eco-friendly and socially acceptable alternative to conventional remediation approaches and help improve the environment. Biosensors enable detection of a potentially infinite variety of compounds and conditions in different environments, a feature that can both deliver tailored treatments and facilitate automation. They thus play a significant role in the “Zero-pollution” monitoring.

The use of natural pesticides (biological pesticides) developed through biotechnology approaches help substituting hazardous chemical pesticides and hence reduce the negative

impacts on the environment and human health caused by chemical pesticides while providing consumers with more choice.

Specify the main expected impacts for this sub-area:

- Enabling zero-pollution circular and bioeconomy value chains
- Tracing environmental sustainability of value chains within Europe and across borders
- New effective remediation methods for pollution
- Increased capacity of environmental monitoring and diagnostic tools
- Improved environmental footprint and lower toxicity of processes, products and services via biotechnologies

For achieving these impacts, topics are considered addressing the following issues:

- Assessing environmental sustainability criteria for biological feedstock and synergies with food production, biodiversity protection or other resources use and ecosystem services (e.g. recreation, urban creep)
- Replacement of toxic substances and materials in industrial processes with lower toxicity bio-based ones.
- Developing pathways to improve the environmental sustainability of bio-based processes in industrial sectors: construction, woodworking, textiles, pulp and paper, bio-chemicals, etc.
- Demonstrating bio-based value chain with improved environmental sustainability
- Enable and demonstrate robust labels and certification schemes of biological feedstock and materials along bio-based value chains
- Promote the sharing of corporate responsibility best practices as regards bio-based innovations, circularity and sustainability
- Build consumers' awareness of certified bio-based value chains
- Improving the bioremediation and revitalization strategies for contaminated environments, including soils and surface water
- Developing high-resolution biosensors and user-friendly diagnostic tools for environmental monitoring and detection
- Developing bio-based safe and sustainable pesticides produced by biotechnological means that replace hazardous and toxic chemical pesticides

## **Destination 5 – Land, oceans and water for climate action**

While Cluster 5 focuses on climate action with notably a destination dedicated to climate science and responses, Cluster 6 will address specific issues related to land, oceans and water.

The conservation and enhancement of Earth’s natural carbon sinks such as soils and plants, forests, farmed lands, the oceans and wetlands is crucial. The European Green Deal green oath to “do no harm”, requires a careful examination of the trade-offs and synergies among the sustainability goals, including health protection, food and nutrition security, ecosystem services and biodiversity preservation both on land and at sea.

Dealing with climate change is a key objective of the CAP and the Farm to Fork Strategy. Agriculture has a significant role to play to reduce and mitigate GHG emissions and to mobilise carbon sinks. It also needs to strengthen its capacity to adapt to climate change and its resilience. The forestry sector faces similar challenges. While knowledge, including environmental observation, is still necessary to understand the impacts of climate change, strong priority needs to be granted to the large-scale deployment of solutions.

Strengthening the ocean and climate nexus is a priority for the EU. There is growing political awareness of the importance of ocean and Polar Regions as an integral part of the Earth’s climate system and of the need to ensure integrity of ocean, Polar Regions and coastal ecosystems in the context of climate change. According to the European Green Deal Communication, lasting solutions to climate change require greater attention to nature-based solutions, including healthy and resilient seas and oceans.

Freshwater resources are increasingly under stress by overuse and climate change with wide-ranging consequences for human societies and ecosystems. It is therefore necessary to define the safe operating space in terms of water quantity and availability, reduce the vulnerability to change and enhance our adaptive capacity.

### Expected impact

Proposals for topics under this Destination should set out a credible pathway to contributing to the following expected impacts:

- Accelerate climate action uptake globally (both mitigation and adaptation), in line with the Paris Agreement and the Sustainable Development Goals
- Mobilise the mitigation potential of ecosystems and sectors based on the management of natural resources
- Support adaptation and resilience of natural and managed ecosystems and sectors based on the management of natural resources
- Advance the understanding and science of the climate-ocean nexus and roll out innovative solutions, in particular nature-based solutions that ensure the integrity of the ocean and its marine and coastal ecosystems in the context of climate change

- Contribute with new knowledge and science to our understanding of the changing climate and its implications, closing the knowledge gaps as identified in IPCC reports and thus, contributing substantially to key international assessments such as the Intergovernmental Panel on Climate Change (IPCC) and strengthening the European research area on climate change and ocean science
- Mobilise the mitigation potential of ecosystems and sectors based on the sustainable management of natural resources
- Support adaptation and resilience of natural and managed ecosystems and sectors based on the management of natural resources
- Inform decision-makers and other relevant stakeholders on how to better manage scarce resources in particular water in a changing climate
- Assess possibilities to strengthen the integration of land, ocean and water adaptation measures in relevant EU policies
- Support the implementation of the European Green Deal and increase the land, ocean and water related investments

### **Understanding the impacts of climate change on primary production and natural systems**

Our understanding of the interrelations between climate change and ecosystems management, protection and restoration is limited while crucial to enable sound decision making for mitigation and adaptation measures. Monitoring and evaluation of the impacts of climate change, land use change and interrelated biodiversity loss on a range of key issues related to agriculture and forestry are crucial to ensure their appropriate contribution the transition to EU net-zero emissions. R&I are also needed to close knowledge gaps in support of decision-making aimed at preserving the integrity of the ocean and the marine and coastal ecosystems in the context of climate change through a better understanding of the drivers of change in the ocean and emerging threats. Moreover, to reduce water vulnerability to climate change, it is necessary to improve the projections of changes in the water cycle at different relevant scales and in the frequency and intensity of extreme events, long-term observations and the assessment of climate change on diverse water uses and on the state of ecosystems and their services.

Main expected impacts for this sub-area:

- Understand the impact of climate change on ecosystems, their wide range of services, and on economic sectors that are based on the management of natural resources on land and at sea
- Increase the availability of tools and technologies for efficient monitoring, assessment and prediction of the status and flows of water, soils and nutrients in primary production
- Reinforce the scientific capacity for modelling and predicting climate-ocean processes, seizing the climate mitigation and adaptation potential of the ocean and the marine and

coastal ecosystems, tackle emerging threats and support decision-making in climate change mitigation and adaptation policies

- Improve reliability of water related projections and impacts
- Identify better the contributions of climate change, land and sea use, human developments and their combination to future water availability
- Strengthen the long term observation and monitoring capacity and accessibility for measuring water and land use changes and assessing water and soil related impacts

For achieving these impacts, topics are considered addressing the following issues:

- Improving understanding of the impact of climate change on the farming sector regarding agro-biodiversity, invasive species, and agricultural production
- Evaluating the impacts of emerging climate risks on EU forest health and services, and in particular on the vulnerability of forest carbon stocks
- Understanding how and why the Atlantic Meridional Overturning Circulation (AMOC) has changed over time, and how it will evolve in the future
- Increasing predictability and reducing uncertainty associated to key processes that link Polar processes, climate change, and people
- Developing tools to monitor land use, soil health, water availability and nutrients flow in agriculture and forestry systems
- Understanding the impacts of climate change in the water cycle; floods and droughts modelling and forecasting; assessment of surface and groundwater water resources vulnerability; observations and monitoring strategies.

### **Reducing GHG emissions and enhancing carbon sinks in primary production and natural systems**

Achieving sustainable land management and efficient use of natural resources that foster climate change mitigation implies finding a right balance between productivity, climate, biodiversity and environmental goals in the agriculture and forestry sectors, with a long-term perspective. R&I activities will support solutions for climate- and environmentally-friendly practices, to effectively reduce emissions of major greenhouse gases and the environmental footprint of land use changes and agricultural activities. New technologies and business models will further enable a “de-fossilisation” of land-based primary production. R&I will unlock the full potential of LULUCF activities in the mitigation of climate change. Results of funded activities will benefit land and forest management and the delivery of multiple services provided by land and forests, such as the provision of goods as long-term carbon sinks in harvested wood products, peatlands and wetlands, the protection of soils, water and biodiversity or their contribution to climate change adaptation and mitigation.

Ocean is as a large storage system for the global reservoirs of climate-regulating factors R&I will advance knowledge innovations to foster ocean-based solutions/mitigation options, helping to closing the emissions gap.

Main expected impacts for this sub-area:

- Fostering climate change mitigation in the primary sector and carbon sinks on land, at sea and in the oceans
- Contribution to EU's climate neutrality target by the optimization and deployment of nature-based solutions on land and in the oceans

For achieving these impacts, topics are considered addressing the following issues:

- Improve understanding of biological processes and interactions under different climate change scenarios to facilitate innovative nature-based solutions for climate change mitigation
- Better understand the role of the land and ocean, and its ecosystems in absorbing and storing CO<sub>2</sub> from the atmosphere
- Establish an EU-wide demonstration network at farm level dealing with mitigation of climate change and carbon storage
- Livestock: fostering climate change mitigation, adaptation and sustainable use of natural resources by improving breeding and feeding
- Improve understanding and measuring the contribution of agroecology and agroforestry to climate change mitigation, soil health and interlinked biodiversity impacts
- Enhancing the mitigation potential of forests by increasing the carbon uptake while preserving the storage and optimising the substitution potential
- Assessment of potential impacts of climate mitigation measures on soils, water, nutrient and ecosystems management, and development of solutions avoiding such trade-offs from the outset, according to the Green Deal's "do no harm" principle

### **Fostering adaptation to climate change of ecosystems, primary production, food systems and the bioeconomy**

Climate change is affecting, and will increasingly affect our aquatic and terrestrial ecosystems, and the services they provide, therefore it is necessary to foster climate adaptation, reduce climate vulnerability and build resilience. Climate change creates stresses on land, exacerbating existing risks to livelihoods, biodiversity, human and ecosystem health, infrastructure, and food systems. Climate change has also an impact on human activities that rely on the availability and use of freshwater, which could be exacerbated by increasingly variable and extreme weather events. Human communities are exposed to climate change, particularly in coastal areas (e.g., sea level rise, saline water intrusion, biodiversity loss, ocean acidification, extreme events and

shrinking cryosphere). R&I aims to deliver on the urgent need to foster the adaptation of primary production to climate change by increasing the resilience of plants and animals to biotic and abiotic stresses. Outputs shall bring more diversity into farming and forestry systems and provide farmers and other actors in bioeconomy value chains with better-adapted crop varieties and animal breeds with lower impacts on related ecosystems. R&I activities for combating desertification can contribute to climate change adaptation with mitigation co-benefits, as well as to halting biodiversity loss with sustainable development co-benefits to society. Avoiding, reducing and reversing desertification would enhance soil fertility, increase carbon storage in soils and biomass, while benefitting agricultural productivity and food security. Water adaptation strategies and approaches will need to be developed and tested. Potential trade-offs and how to mitigate and avoid them will need to be assessed to ensure environmental sustainability. Important water use economic sectors will have to develop appropriate solutions to adapt to decreased water availability for business and ecosystems. Adapting water and soils to climate change will also require developing appropriate water allocation schemes, activities combating desertification and understand how institutions and behaviour shape vulnerability, offer opportunities for adaptation and promoting ways that encourage water conservation, prevention

Main expected impacts for this sub-area:

- Foster resilience and adaptation of natural and managed ecosystems and related bioeconomic sectors dealing with the management of natural resources and land use change, including through nature-based solutions.
- Unlock the potential of nature-based solutions for coastal seabed resilience and the positive effects of blue carbon on climate change adaptation.
- Improve the adaptive capacity of water and soils systems and sectors and help avoiding or mitigating complex trade-offs between various relevant policies.
- Promote a culture of adaptation to various water and soil stakeholders and decision makers and trigger the emergence of wider initiatives for solutions to water, desertification and climate issues with strong public participation.

For achieving these impacts, topics are considered addressing the following issues:

- Testing, investigating and improving the performance of existing nature-based solutions for coastal seabed resilience, as well as to design and implement several pilot projects distributed in different geographical locations in Europe. Quantification, predictability and long term sequestration potential of the coastal blue carbon, and its positive side-effects in climate change adaptation
- Investigating the conditions for resilience of the farming sector in the short- to long-term and support mitigation and adaptation strategies at sectoral / regional levels
- Enhancing the resilience and improving the adaptation of forests and the forest-based sector, including through nature-based solutions

- Preserving and exploiting the full potential of forest genetic resources (FGR), and assessing its impacts
- Improving crop selection for a more efficient crop production in relation to climatic variables, impacts on ecosystems, soil and water availability
- Improving irrigation and fertilisation systems to enhance water management and efficiency under climate change conditions and for minimising negative impacts on biodiversity and soils
- Developing water allocation systems and models in different regions; water valuation and economic tools; adaptation of various water dependent sectors and ecosystems to water scarcity; resilience of coastal zones to the increased events of rivers and coastal floods and storms; adaptation of water urban infrastructures (including of nature-based solutions) to climate change impacts; risk management plans and vulnerability assessments; strategies to increase water adaptation related investments

## **Destination 6 – Resilient, inclusive, healthy and green rural, coastal and urban communities**

The Sustainable Development Goals, and the ecological and digital transitions brought forward by the European Green Deal and Digital package, in the context of the recent pandemic, bring challenges and opportunities that differ depending on where people live and work. Knowledge and innovative solutions need to be developed to enhance every community's resilience and capacity to contribute to and benefit from these transitions in order to leave no one behind.

Under this destination, transdisciplinary R&I with a strong social and behavioural sciences dimension, and attention to gender aspects, will foster a sustainable, balanced and inclusive development of rural, coastal and urban areas. The differential impacts of climate, environmental, socio-economic and demographic changes on rural, coastal and urban areas will be better understood and, where possible, turned into equal opportunities for people wherever they live, enhancing territorial cohesion. People will have more equitable access to knowledge and skills required to make informed choices and be actively engaged in sustainable management of natural resources, from production or service provision to consumption and disposal. Rural, coastal and urban communities, in particular women, youth, the most vulnerable groups and those hit the hardest by the COVID-19 pandemic, will see their labour conditions, quality of life and long-term socio-economic prospects improved in the context of major transitions and rising climate change and health threats. Their capacity to drive community-led innovations has to be enhanced and their resilience increased. Mobilising the forces of digital transformation, nature-based solutions, as well as social and policy innovation will facilitate necessary changes and support smart, environment and climate friendly and resilient lifestyles.

### **Expected impacts**

Proposals for topics under this destination should set out a credible pathway to contributing to the following expected impacts:

- Social inclusion and gender balance are improved, inequalities are reduced; people skills are upgraded and communities empowered to act for change through innovative governance that favours an integrated and interlinked territorial development, which is needed to achieve the Green Deal.
- Rural, coastal and urban communities are better prepared to achieve climate neutrality, adapt to climate change, and turn digital and ecological transitions into increased resilience and positive long-term prospects.
- Innovative solutions make rural communities smarter. Access to services, opportunities and adequate innovation ecosystems is increased, including for women, youth and for most vulnerable groups, and the feeling of being left behind is reduced.
- Sustainable development of coastal areas and nature-based coastal protection and resilience are enabled by new social, economical and governance frameworks.

- Coastal areas reap the benefits of social, digital and community-led innovations to deliver nature-based and scientifically validated solutions to existing coastal socio-economic and environmental threats.
- Urban food environments are re-shaped to become healthier, so that people can access, afford and choose healthier and nutritious food. Urban and regional food systems are also more circular.
- The resilience and social inclusion of local communities and regions are increased, drawing on nature-based solutions.

For achieving these impacts, topics are considered addressing the following issues:

- Sharpening evidence on rural areas diversity, functional links with other territories, preparedness to climate change, digital and ecological transitions and other long-term threats or trends, well-being and labour and social conditions
- Policy benchmarking and innovations improving social inclusion, women empowerment and the resilience of vulnerable groups in rural areas
- Accelerating rural innovation to address social challenges alongside the digital and ecological transitions, boosting smart villages<sup>16</sup>, social innovation and enhancing rural innovation capacities in Europe and beyond
- Improving integration of marine ecosystem services' valuation, conservation and restoration in socio-economic models, through lasting cooperation and social innovation in different regional contexts
- Promoting social transition by increasing the socio-economic empowerment of the users of the sea, improving their "Green and Blue or Ocean Literacy"
- Building evidence on existing urban food systems, governance models and on the impact of food policies, as well as experimenting and innovating for new governance models and policy frameworks
- Promoting the development of integrated urban food policies and planning frameworks linking health, environment and food systems, bridging the national, regional and the local level and including risk prevention and reduction plans to anticipate and manage food systems shocks
- Promoting innovation – and in particular social innovation – in sustainable food procurement, distribution, logistics and in the new forms of food sharing economy. Supporting the increase of circularity in urban food systems in the context of the Circular Cities and Regions Initiative (CCRI)

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<sup>16</sup> [https://enrd.ec.europa.eu/smart-and-competitive-rural-areas/smart-villages/smart-villages-portal\\_en](https://enrd.ec.europa.eu/smart-and-competitive-rural-areas/smart-villages/smart-villages-portal_en)

- Understanding of the economic, social, political and cultural dimensions of designing, implementing and upscaling nature-based solutions in rural, coastal and urban communities
- Demonstrating innovative and resilient nature-based solutions for addressing in a sustainable and systemic way challenges related to climate, pollution, primary production, education for sustainability and health

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## **Destination 7 – Innovative governance, environmental observations and digital solutions in support of the Green Deal**

Implementing innovative solutions to deliver the European Green Deal, while ensuring that no one is left behind, will require complex decisions, given the interdependencies across existing policies. Therefore R&I on governance is crucial. At the same time, specific knowledge and innovative solutions to support policy making to implement the Green Deal initiatives are needed. This should be done by taking advantage of the use, uptake and deployment of Environmental Observation as well as digital solutions, assessed through the “do no harm” principle of the Green Deal. This should lead to more science-based policy design, implementation and monitoring. To maximise impacts of R&I on the ground and spark behavioural and socio-economic change, participatory and place-based innovation shall be encouraged. Furthermore, the dissemination of knowledge and innovation to key stakeholders, in particular through effective Agricultural Knowledge and Innovation System needs to be supported to accelerate the required transformative changes.

### Expected impact

Proposals for topics under this Destination should set out credible pathways to contributing to the following expected impacts:

- Better informed decision-making processes leading to tailored governance models
- Provide strong evidence-based knowledge and tools to support policy development, implementation and monitoring for achieving the necessary transformative changes
- Develop European monitoring and observing capacities necessary to achieve policy and societal objective of this cluster
- Enhance the use and uptake of information coming from Environmental Observations in support of the Green Deal objectives and domains central to the Green Deal
- Enhance understanding of Earth systems, enable knowledge-based decision-making by authorities, industries and citizens
- Boost the use of digital and data technologies to assess socio-economic and environmental aspects, systems and flows that will provide solid and reliable information and enable sound decision making and adaptation measures
- Deepen the knowledge on and further develop cost-effective digital and data-base solutions enhancing the sustainability performance and competitiveness of agricultural production, forestry, rural areas, food, bioeconomy, and the blue economy, overcome uptake barriers and increase effective deployment
- More informed and engaged stakeholders including primary producers and consumers
- Better informed decision-making processes leading to tailored governance models.

## **Innovating with governance models and supporting policies**

R&I for governance to support the Green Deal shall provide insights into institutional barriers such as lock-ins, path dependency, bounded rationality, political inertia and power imbalances. They are also key for providing also solutions for improved knowledge management, dissemination and utilisation. R&I can help also to harness complexity inherent in policymaking and address the challenge to develop a coherent landscape of European, national or regional policies that fully integrate the environmental, social and health requirements and considerations.

Specify the main expected impacts for this sub-area:

- Contribute to establishment of innovative governance models enabling sustainability in collaboration with international partners through enhanced use of new knowledge, tools, foresight, environmental observations as well as digital, modelling and forecasting capabilities.
- Support development, implementation and monitoring of policies supporting the Green Deal .
- Develop innovative tools to assist different levels of government and other stakeholders in engaging effective, fair and sustainable policies, and ratcheting up commitments.
- Ensure long-term economic sustainability and modernisation, driving the necessary adjustment in all sectors to operate within the sustainability limits.

For achieving these impacts, topics are considered addressing the following issues:

- Innovative governance models enabling sustainability are established in collaboration with international partners through enhanced use of new knowledge, tools, foresight, environmental observations as well as digital, modelling and forecasting capabilities.
- Regional governance models; governance transition through improved multi-layer management and collaborative governance performance in the areas covered by Cluster 6.
- Innovative governance approaches indicators. Innovative mechanisms to promote stakeholder engagement and promote social innovation. Development and testing of appropriate economic policy instruments, financing and business models in the areas covered by Cluster 6.
- Demonstrations of new approaches for instance in water management.
- Accelerating regulatory transition through building evidence on inconsistencies or weaknesses in environmental and social cross-compliance of policies, legislation and regulation.

- Co-evolution of the regulatory and assessment environment of biotechnology with scientific and technological developments, with co-creation and trust-building measures.
- Enable the digital transition in governance and sustainability indicator monitoring and labelling in order to reach sustainability.
- Improving education governance for sustainability for young people and their families; education in Europe.
- Develop innovative tools and methods to support design, monitoring and implementation of CAP Strategic Plans
- Strengthening databases, analytical tools, modelling and foresight to support policy enabling transition to sustainable farming within planetary boundaries (focus on trade-offs and synergies)
- Sustainability labelling options; cost-effective certification systems
- Deployment of food systems transformation
- Integrating a science service on research-based options for ratcheting up the implementation of biodiversity commitments into the EU Biodiversity Strategy
- Supporting the Intergovernmental Science-Policy Platform for Biodiversity and Ecosystem services (IPBES), and science cooperation within the Convention on Biological Diversity (CBD)

### **Deploying and adding value to Environmental Observations**

Data and information obtained through Environmental Observation is of great value when assessing the state of the planet and is delivering crucial information to support the Green Deal. Integration of this information from different sources (space-based, airborne, in-situ and citizens observations) with other relevant data and knowledge while ensuring (better) accessible, interoperable or deployable information, delivers information necessary for shaping the direction of the development of policies in the broad context of Cluster 6 of the Horizon Europe Programme. The actions under this sub-section will cover biodiversity status, ecosystem protection and restoration, climate change mitigation and adaptation, food security, agriculture and forestry, land use and land use change, urban and peri-urban development, natural resources management, sea and ocean resources management and conservation, maritime security, long term environmental trends, changes in seasonal variability, ambient air and atmospheric changes and other relevant domains.

A strong link to the European Earth observations programme Copernicus as well as support to the Group on Earth Observation (GEO), its European regional initiative (EuroGEO) and the Global Earth Observation System of Systems (GEOSS) is foreseen for all topics under this subsection. Activities relevant to oceans, seas and coastal waters will be framed under the UN

Decade of Ocean Science for Sustainable Development and of Restoration, the G7 Future of the Seas and Oceans, the Destination Earth initiative, the European Global Ocean Observing System (EOOS) and the GOOS 2030 strategy.

Specify the main expected impacts for this sub-area:

- Delivery of climate services (e.g. *forecasting for accurate and reliable warning*) for climate adaptation and mitigation in the different areas covered by cluster 6 using the broad range of environmental observations
- Better accessible and exploitable environmental knowledge and data including for policy and science breakthroughs
- Decreasing the in-situ gaps and ensuring availability and acquisition of long time series across the thematic areas of cluster 6 with a specific emphasis on the lesser observed domains through cost-effective and comprehensive observation systems, enabling knowledge-based decision-making.
- Better usage of the wealth of data acquired by citizens, to support acquiring information, and policy-making and implementation in the environmental and other domains, and empowerment of citizens in monitoring, shaping and participating in the climate transition.
- Better use of the opportunities and possibilities Environmental observations offer in the specific sectors of One Health, Ocean, Renewable Energy and Transport.
- Support the European contribution to the implementation of the Global Earth Observation System of Systems (GEOSS)

For achieving these impacts, topics are considered addressing the following issues:

- Development of end-user solutions building on environmental observation in the specific area of ecosystem and biodiversity adaptation and mitigation and risk management in response to climate change
- Tools to support the uptake and accessibility/exploitability of environmental observation information at global level (GEOSS, (Ocean) Digital Twin), and their integration into governance systems
- Green Deal data space to provide better accessible and exploitable data in support of the Green Deal priority actions
- Creation of in-situ spatial reference data and temporal series in critical areas not well covered and unlocking existing datasets in the context of filling in-situ observation gaps
- Uptake and validate of citizen observations to complement scientific and authoritative measurement and boost citizen engagement

- Environmental observation contributing to the One Health domain
- Build on new technologies for collecting/acquiring new in-situ data through observations
- Use of environmental observation in developing renewable energy

### **Digital and data technologies as key enablers**

Digital innovation can bring enormous benefits for citizens, businesses, researchers, the environment and society. It is reshaping the way we produce, consume, and do research. Its tools help researchers and policy makers to make better use of data for monitoring and for generating new insights. It provides us the potential to manage resources better and care for ecosystems without exceeding finite boundaries.

The practical application and deployment of digital and data technologies - and of related solutions - is therefore a key instrument to increase the competitiveness and sustainability performance of the agricultural, food, forestry, biobased and blue economy sectors, to engage consumers and communities more directly, to improve transparency, to improve quality of life and work, as well as to enhance administrative processes, and strengthen monitoring, policy making and foresight capacities. New approaches to use the potential of data, data technologies and digital technologies need to be developed, piloted and scaled-up, well reflecting that tailored data from a quality and quantity point of view will increase the effectiveness of digital technologies and boost their deployment.

Digital solutions in and across primary production sectors, linked value chains, communities, governments, markets, and ecosystems. R&I will improve the knowledge of the added value and cost-effectiveness of these technologies and solutions, develop them further for use in specific contexts (socioeconomic and environmental), generating key data sets, and raise awareness about their benefits and impacts. Enhanced capacities to use and scale-up digital technologies and solutions in practice will foster excellence to realise the full potential of digital and data technologies. The potential of the ongoing digital transformation, and its wider (positive and negative) impacts will be better understood and seized.

Specify the main expected impacts for this sub-area:

- Producers, consumers and communities are enabled to achieve climate neutrality, reverse biodiversity loss, improve sustainability, resilience and circularity, while also improving competitiveness, fairness and inclusiveness;
- New knowledge, tools, foresight, and environmental observations as well as digital, modelling, scenario and forecasting capabilities to support governance at all levels, monitoring and research, and to ensure food and nutrition security for all while ensuring biodiversity protection are better used;

- Cost-effective digital solutions enhancing the sustainability performance and competitiveness of agricultural production, forestry, rural areas, food, biobased, and the blue economy and overcome uptake barriers are further developed and better known;
- Data sharing and reuse in the domains of Cluster 6, within and across sectors, value chains, areas (rural, coastal, urban), communities, governance systems, and scientific fields is increased
- The potential of (large-scale) digital infrastructure including infrastructure for big data for agriculture, forestry, rural areas, food, biobased, and the blue economy is exploited
- Comprehensive and systemic approaches towards digital and data technologies for agriculture, forestry, rural areas, food, biobased, the blue economy and policy implementation are fostered
- Governance of the data economy in the domains of cluster 6 is strengthened, by improving the understanding and monitoring of the environmental, socio-economic, behavioural and demographic drivers of digital transformation, as well as its potential and its impact

For achieving these impacts, topics are considered addressing the following issues:

- Assessing sustainability gains of digital technologies in the agricultural sector
- Cost, benefits and environmental impacts, including on biodiversity and climate of precision farming and of digital and data technology based agricultural production
- Smart solutions for the use of digital technologies for small- and medium-sized farms
- Data economy in the field of agriculture – effects of data sharing and big data
- Feeding and tailoring farmers' and advisors' applications – big data generated globally applied locally
- Upscaling (real-time) sensor data for EU-wide monitoring of production and agri-environmental conditions
- Plant protection through robotics and robotics force in the agricultural sector, its socio-economic impacts, and mitigation options for areas in transition
- Public good provision through digital and data technologies in the agricultural sector – designing policy measures
- Potential of drones as multi-purpose vehicle, e.g. for production assessment, pollination, cover-crop seeding and environmental observation (including landscape features, forests and soil carbon) and for rural services, asses their risks and added value

- Develop innovative, cost-effective and resource-efficient blockchain-based approaches to increase the traceability of agricultural products
- Exploiting the potential of EU-wide (geospatial) agricultural data for the application of data technologies
- Smart 5G, last-mile and edge solutions for remote rural areas
- Development of the markets and use of digital technologies and infrastructure in agricultural – state of play and foresight: digital- and data technologies for the agricultural sector in fast changing regulatory, trade and technical environment
- Enhance knowledge on the technology needs in primary production and the food chain to enhance diversity, resilience and increased circularity of farming systems
- Mapping, understanding and optimizing the data economy for food systems
- Piloting new approaches and tools to empower citizens to exercise their “data rights” (personal data protection and data sovereignty) in the area of food and nutrition
- Increasing the transparency of the food system to boost health, sustainability and safety of products, processes and diets
- Servicing data needs of farmers and food businesses through data cooperatives

### **Strengthening agricultural knowledge and innovation systems**

Knowledge and advice to all actors in the food and bio-based system are key to improve sustainability. Primary producers have a particular need for impartial and tailored advice on sustainable management choices. Effective Agricultural Knowledge and Innovation Systems (AKIS) are key drivers to enhance co-creation and thus speed up innovation and the take-up of results needed to achieve the Green Deal objectives and targets. This will include promoting interactive innovation and co-ownership of results by users, as well as strengthening synergies with other EU Funds in particular the CAP, reinforcing the multi-actor approach and setting up structural networking within national/regional/local AKISs. AKIS is not limited to agriculture but includes whatever farming and rural activities relate to, such as environment, climate, biodiversity, landscape, biobased economy, consumers and citizens, i.e., all food and bio-based systems including transformation and distribution chains up until the consumer.

The main expected impacts for this sub-area are:

- Improve awareness and knowledge exchange of key actors in the food and bio-based systems on impacts of their systems on the environment and on innovative solutions for increased competitiveness and sustainability
- Improve long-term access to and sharing of practical knowledge produced by the Horizon 2020 multi-actor projects and EIP-AGRI operational groups between as many geographical areas in Europe as possible, improving dissemination to end-users

- Favour greater access, interoperability and integration of EU and Members States' knowledge bases for practitioners
- Enhance the impact of advisors on the strengthening of knowledge flows between research and practical implementation by building advisory networks on topics related to the Green Deal objectives
- Increase the use of more sustainable farm techniques through activities within a European network of demonstration farms in all EU Member States and regions, where farmers can learn in a peer-to-peer mode on normal farms on a variety of issues related to the Green Deal objectives;
- Support to AKIS policy implementation in MS, in particular by development of material and dedicated training systems for AKIS actors and exchange of experience, methods and tools among AKIS actors and coordinators

For achieving these impacts, topics are considered addressing the following issues:

- Thematic networks to compile and share knowledge ready for practice, including from EIP-AGRI Operational Groups with and without pre-defined themes
- Thematic networks and advisory networks with predefined themes in particular aiming at Green Deal issues (e.g. agroecology, climate, pesticide reduction, reduction of water use, producer-consumer connections etc)
- Building an EU wide interactive knowledge reservoir to support knowledge exchange between all actors by means of integration into the AKISs in MS
- Exploring and improving national/regional AKIS organisation, and access to information
- Strengthen the multi-actor aspect of projects
- Deepening innovation support

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