European Research Council
Established by the European Commission

European Commission

Mapping ERC Frontier Research
Sustainable food production and consumption

Introduction

The European Research Council (ERC) is the premier European funding organisation for excellent frontier research. It has been a key component of the EU's funding programmes for research and innovation since it was set up in 2007. It gives its grantees the freedom to develop ambitious research projects that can lead to advances at the frontiers of knowledge and set a clear and inspirational target for frontier research across Europe.

The ERC funds a rich and diverse portfolio of projects in all fields of science, selected without any predefined academic or policy priorities. These projects can have an impact well beyond science, and provide frontier knowledge and innovation to help solve societal challenges and inform EU policy objectives. This report highlights how ERC funded curiosity-driven research contributes to policy impact.

ERC research contribution to the EU's Food 2030 pathways

Promoting sustainable food production and consumption is a major challenge intrinsically linked to our health and to the health of our environment and planet. This report presents a portfolio analysis of ERC funded projects relevant to the EU's research and innovation Food 2030 policy. The latter aims to transform food systems and ensure everyone has enough affordable, nutritious food to lead a healthy life. Its objectives cover the entire food system: from primary production by land and water to food processing, retail and distribution, packaging, waste and recycling, catering services and consumption. It supports the EU Farm to Fork and bioeconomy strategies with the overall ambition towards a climate neutral Europe. It also directly supports the EU's Green Deal objectives through the transformation of our food systems to ensure they are sustainable and resilient.

The Food 2030 policy aims to achieve a resilient food system that is fit for the future. The policy is articulated in four key goals and ten pathways for action to help obtain these goals. The four Food 2030 priorities are: 1) Nutrition for sustainable and healthy diets, 2) Climate smart and environmentally sustainable food systems, 3) Circular and resource-efficient food systems and 4) Food systems innovation and empowerment of communities.

The pathways are ten key areas where research and innovation can have a major impact in supporting sustainable food systems.

This report highlights ERC projects funded under the H2020 Framework Programme for Research (2014–2020)[1] and a selection of FP7 projects (funded between 2007-2013) that provide new knowledge, new perspectives or innovative solutions to the areas identified under the ten pathways in the Food 2030 policy.

Distribution of the projects across scientific domains[2]:

Figure 1

102 projects

EUR 228 Million

38 projects	50 projects	8 projects	6
Social Sciences and Humanities	Life Sciences	Physical Sciences and Engineering	Interdisciplinary Synergy projects

[1] These projects were funded under the H2020 Starting, Consolidator, Advanced or Synergy grants.
[2] The numbers presented in figure 1-4 include H2020 projects only.

Methodology

An internal classification exercise assisted in identifying a pool of 270 projects out of 6707 H2020 funded ERC projects relevant for the Farm to Fork strategy. These projects are presented in the factsheet: ERC frontier research contribution to the European Green Deal. A more in-depth analysis of this pool resulted in 90 projects considered as relevant to the topics covered by the ten pathways in the Food 2030 policy. An additional targeted keyword search resulted in 12 additional H2020 projects that were not part of the original pool.

This report also highlights a few examples of FP7 projects based on their relevance to sustainable food production and consumption.

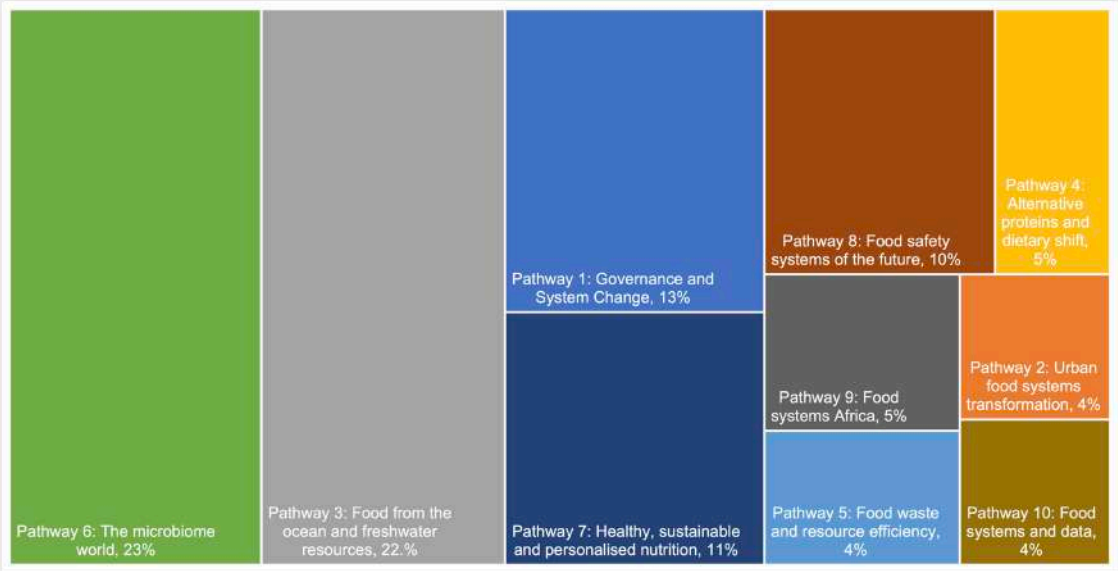
Projects funded under Horizon Europe (granted from 2021 on) are not included in this report since they are still in the early phases of implementation.

While the Food 2030 pathways integrate land and see, spanning from production to consumption, they do not cover all the areas requiring food system intervention. Other key areas of work related to sustainable primary production, biodiversity, water management and rural development aspects are dealt with in other parts of Horizon Europe, which include research and innovation on healthy soils, agroecology, alternative pesticides, rural growth, precision farming and SME interactions along the food chain. Accordingly, only those ERC projects that are deemed directly relevant for the ten Food 2030 pathways, as described in the corresponding policy, are included in this report.

Connection between ERC projects and the Food 2030 pathways

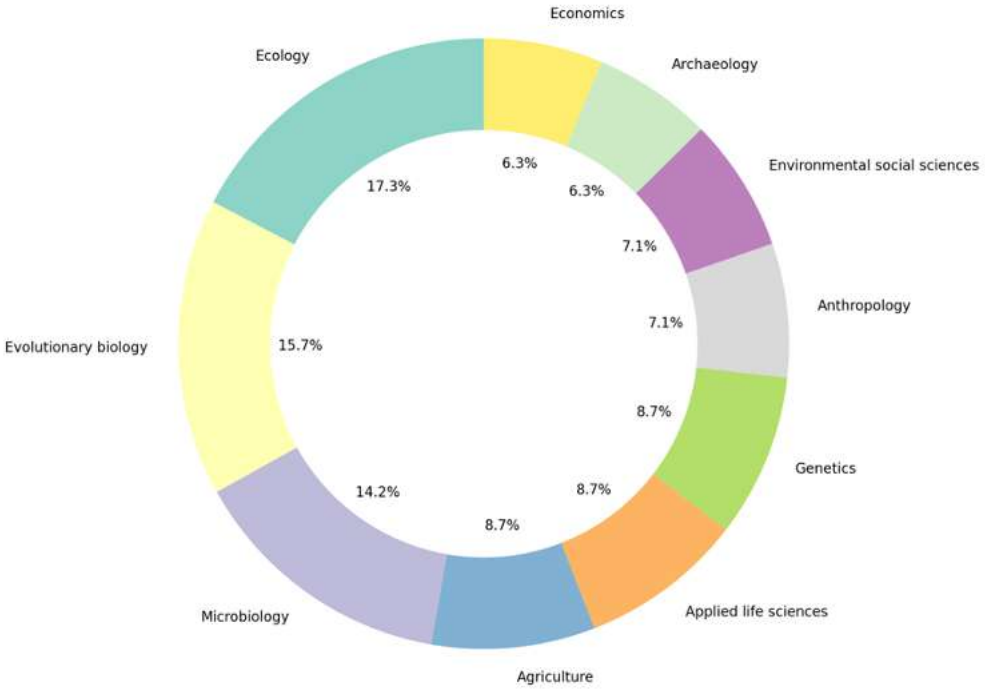
The size of each square is proportionate to the number of projects relevant for each pathway. One project may be relevant for more than one pathway.

Figure 2



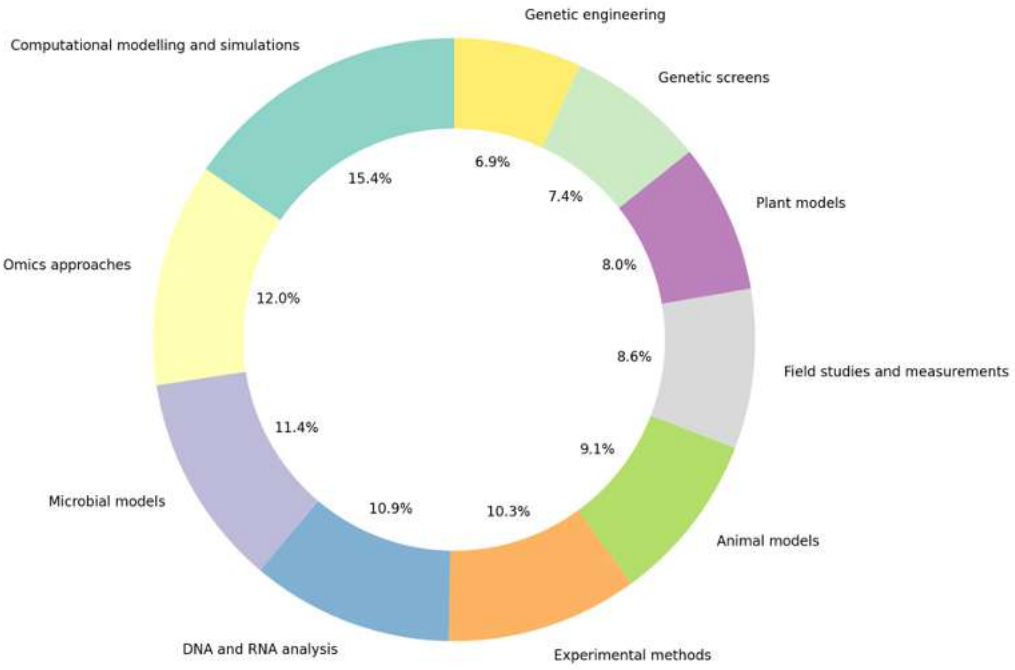
The ten most used disciplines among all the projects

Figure 3



The ten most used methods among all the projects

Figure 4



ERC projects and the ten pathways for action: examples

ERC projects are expected to push the frontiers of knowledge. While no immediate application is anticipated ex ante, many ERC projects deliver tangible results and close-to-market solutions. In this section, we highlight projects funded under H2020 and FP7, contributing knowledge and innovation to enhance the sustainability of food systems closely linked to the ten pathways.

1. Governance and system change

Food systems involve many different actors from various sectors, including nutrition, health, environment, industry, business and trade. These systems face multiple challenges and have an impact on climate, health and the livelihoods of many people. Achieving sustainability in food systems requires overcoming major policy, regulatory, financial, technological, and behavioural barriers.[3]

ERC projects relevant for these policies come mainly from the social sciences. Among other topics, they look into supply chains and their impact on forest conservation and livelihoods; the emergence of new water justice movements with the potential to shape equitable and nature-based water governance; the effects of certification strategies, such as fairtrade, by testing the transformative potential of the concept of environmental justice; legal tools for scholars and stakeholders to manage competing interests in the offshore economic sector as well as how the interaction of little material-semiotic tools determines success or failures in the emerging bioeconomy. Other topics include climate change and conflict, equality and access to food and the link between food security and biodiversity as highlighted below.

- Among the many foreseeable impacts of climate change, increased prevalence of violent conflict and disintegrating societies are the most devastating. However, we lack knowledge on the precise links between climate change and violence. The CLIMSEC project analyses **how food security** and the economic impacts of climate variability **impact political violence** via an innovative use of existing methods and data. Learn more about the project and its findings in this article and in this podcast, as well as on their website.
- Inequality has far-reaching ramifications for human well-being. Inequality also links to oceans, which produce vital food and enable jobs and economic activities, and which are also facing unprecedented pressures from human activities and climate change. Social, cultural and health factors in **ocean inequalities** remain largely unknown. The EQUALSEA project develops a new transformative adaptation framework for understanding and addressing ocean inequality to monitor progress towards ocean equity. You can follow their work and read more about the project on their website.
- **Conflicts between food security and biodiversity conservation** are increasing. Uncertainty, for example from climate change, decreases food security, puts further pressure on biodiversity and exacerbates conflicts. The ConFooBio project developed a novel model that predicts solutions to such conflicts by integrating game theory and social-ecological modelling. Read more about the application of game theory to food security-biodiversity conflicts in this article.
- The SESyP project, funded under FP7, also addressed this issue and developed a global theory to explain which properties of social-ecological systems benefit both biodiversity conservation and food security. SESyp took a holistic, systems-oriented approach drawing on both the natural and social sciences. Read more about the project on their website.

[3] EC/European Commission (2020), Food 2030 pathways for action – Research and innovation policy as a driver for sustainable, healthy and inclusive food systems.

2. Urban food systems transformation

Today, most of the world's population live in urban areas, and this proportion may increase to over 70% by 2050.[4] As 79% of the total food production is intended for consumption in cities[5], urbanisation is directly linked to the changing demand for food.[6]

Challenges to urban food systems include food waste and greenhouse gas emissions associated with food. As urbanisation grows, the relationship between food, health and socio-economic inequalities in cities presents a significant challenge, with food access and hunger becoming an issue also in cities in high-income countries.

- The unequal distribution of entitlement and access to food is increasingly a feature of wealthy western societies, arising in the context of global crises and governmental policy. The FFP project, funded under FP7, carried out a large-scale study of parents' and children's experiences with food poverty in the UK, Portugal and Norway involving 133 low-income families living in or near the capital cities of the three countries. The final output of the project and their recommendations on **how to tackle food poverty are available online**.
- While urban sites are contributing significantly to greenhouse gas emissions, they can at the same time implement green infrastructures for food production, promote air quality and temperature and reduce environmental impact. The URBAG project investigates how urban **green infrastructures** can be most efficient in contributing to urban sustainability. Learn more about the project on their website.
- Population growth and economic development have dramatically increased the **demand for food and water**, and urban groundwater use has risen exponentially to meet the ever-increasing population growth of mega-cities. To address this challenge, the GEOWAT project uses modelling tools, in combination with dedicated case studies, to study the global volume of physically and economically extractable fresh groundwater to provide new knowledge for **sustainable groundwater use**. Follow the project on their website.
- The Water-Futures project also tackles the issue of water resources in urban settings. The project develops a new theoretical framework for allocation and development decisions concerning **drinking water infrastructure systems that are socially equitable, cost-efficient**, and meet the UN Agenda for 2030 Sustainable Development Goals. The framework will integrate real-time monitoring and control with long-term robustness and flexibility, incorporating economic, social, ethical and environmental considerations for the sustainable transitioning of urban water systems. Read more about the project on its website.

3. Food from the ocean and freshwater resources

Seafood production through harvesting (fisheries) and farming (aquaculture) is key for European and global food and nutrition security, according to the Scientific Opinion provided by the Scientific Advisory Mechanism High Level Group of Scientific Advisors.[7] However, Europeans consume roughly twice as much seafood as they produce. Fisheries in the EU have faced collapses of major stocks due to overfishing and the general degradation of marine ecosystems.

As figure 2 above attests, many ERC projects work on how to improve the health of the ocean, and some directly focus on fisheries or aquaculture, which is foreseen to have the potential to be able to supply close to two thirds of global seafood consumption by 2030. Algae farming might be the next big thing for food and feed production but in Europe its potential is not yet fully exploited.[8]

- With the aim to have a beneficial impact on the European microalgae industry and nutraceuticals market, the ASTAOMEGA project developed an innovative and commercially competitive production platform for high value products like **Astaxanthin and Omega-3, to be used for**

[4] EC (2020). See also: World Economic Forum (2017), Project MainStream. Urban Biocycles, FAO (2019), Framework for the Urban Food Agenda
[5] EC (2020). See also: FAO (2019), FAO Framework for the Urban Food Agenda
[6] EC (2020). See also: Scientific Advice Mechanism (SAM) (2020), Scientific Opinion - Sustainable food system.
[7] SAM/Scientific Advice Mechanism (2016), Scoping paper - Food from the Oceans.
[8] EC (2020)

human nutrition or aquaculture. Read about how they used a marine algal species (Nannochloropsis gaditana), which accumulates high levels of the omega-3 fatty acid eicosapentaenoic acid (EPA) to also produce the antioxidant astaxanthin.

- To ensure the **sustainability of the aquaculture sector**, which is the fastest growing food production sector in the world, it is critical to domesticate and selectively improve the major commercial fish species. The EPIFISH project used the Nile tilapia (Oreochromis niloticus) as model species through a multidisciplinary approach. The project provided novel insights into the **role of epigenetics in fish domestication**, which will open new horizons for future frontier research in epigenetics. Read more about the project in this article.
- **Food security** is one of the great challenges of our time, but many factors hinder meeting global targets set in the "Zero Hunger" UN Sustainable Development Goal. Two billion people are thought to be micronutrient deficient. Yet, in many poor countries, fish could provide a readily available and cheap source of micronutrients and protein. At the same time, we do not have a systematic understanding of which species are most likely to address the most pressing nutritional needs. The FAIRFISH project explores the ecological and socio-cultural determinants of the **nutritional contributions small-scale fisheries** make to human health. Read more about how fish can help tackle malnutrition.

4. Alternative proteins and dietary shift

Changing and diversifying our diets can be a way to reduce anthropogenic greenhouse gas emissions from food production, address the challenges of changes in land use and biodiversity loss, while providing sufficient, nutritious, safe and affordable food to a fast-growing population. Excess red and processed meat consumption has significant negative effects on human health, especially in western diets. Many sources of proteins other than meat (e.g. alternative proteins) exist within the current assortment of food products (e.g. edible insects, cultured meat, fungi and microalgae).[9]

ERC projects address the challenge of finding food alternatives to meet the demands of a growing population worldwide, mainly focusing on plant foods.

- Foraging is a global phenomenon that has gained in relevance around the globe. At the same time, the climate crisis and concerns for the rapid loss of biodiversity are raising the urgency for environmental conservation. The FORAGING project focuses on **foraging as a basic economic strategy** and a form of socio-environmental entanglement and develops a political ecology of foraging in the Anthropocene.
- Forests are full of nutritious wild food that can provide rural villagers with a free or affordable source of diet. Paradoxically, current development efforts to increase food security often lead to the destruction of forests in order to make land available for agricultural production, often resulting in poorer diets.

The FORESTDIET project is providing empirical evidence of how and why **forests influence dietary quality in low-income countries**. Read the article on how to achieve a more integrated approach to agriculture and forests to achieve better quality diets.

[9] ibid.

- Humanity is facing a huge challenge, namely, how to feed a growing population in a sustainable way. The ReSEED project is examining the **history of seeds in Europe** as far back as the 16th century to find ancient local varieties that could help modern agriculture become more sustainable. With this information other researchers could extract ancient traits from old seeds and combine them with modern seeds. This would allow any farm to grow crops with ancient, localised traits, such as less need for water and fertilisers, or a greater ability to survive in extreme weather or improve local biodiversity. Read more in the article about the project and its findings.

Other projects look to the past to learn more about the diets of hunter-gatherers and why hominins chose to eat certain plants.

5. Food waste and resource efficiency

Food intended for human consumption that is eventually lost or wasted contributes to food insecurity and hinders nutrition, in a world where one in nine people are undernourished.[10] It has been estimated that the food currently wasted in Europe could feed 200 million people.[11] Food waste is also an environmental problem because food production is resource intensive. Without a change in dietary habits and the reduction of food waste, the expected growing population and incomes will lead to an increase in demand of agricultural products of 50 % by 2050.[12]

- In a context of rapid urbanisation and growing clarity regarding the unsustainability of cities, the project SHARECITY examined **city-based food sharing economies** and their potential to reorient eating practices. The project developed the first ever crowdsourced international food sharing database and the principal investigator won an ERC Public Engagement with Research Award for her team's work. Watch Professor Davies from Trinity College Dublin explain how urban food systems can be more sustainable and help prevent food waste, and read about how citizens are using the database and app to learn more about existing food sharing initiatives.
- The GasApp project has provided a tangible solution to reduce food waste. Building on research into new tools for obtaining cheaper and better performing gas sensors, the PI and his team developed a smartphone app that can provide **real-time information on the edibility and freshness of packaged food**. The technology the app builds on can empower customers and improve the entire supply chain process. It has resulted in the start-up company, ColorSensing, founded in June 2018. Read more in this article about the project.
- The FP7 funded CONANX project investigated **consumers' concerns** over quality and freshness, possible health risks, safety and various ethical issues related to food. Unlike many previous studies, the project observed consumer practice rather than relying on statistical evidence from surveys. This qualitative approach found that consumer behaviour is less influenced by personal anxieties than statistical data might suggests, and that **social and cultural influences** have a strong impact on the individual choices people make regarding food consumption. Taking this into account could help policymakers better promote healthy, sustainable behaviour.

[10] EC (2020). See also: UN World Food Programme (WFP)
[11] FAO (2012), Global food losses and food waste – extent, causes and prevention.
[12] EC (2020)

6. The microbiome world

A microbiome is a community of microorganisms that live in a confined environment. Soils, oceans and food host microbiomes, as do plants, animals and the human body. Microbiomes have an impact on our health and on the food we produce, as well as on ecosystems in general.

As figure 2 above attests, ERC projects, mainly from the life sciences domain, study microbiomes and the solutions they may generate for our nutrition and health and for food safety.[13]

- The MetaPG project applied computational biology to bridge the gap between the fields of metagenomics and population genomics to unravel the population structure of hundreds of uncultivable gut microbes. The project identified those **microbial strains that are currently disappearing** in westernised populations as a consequence of urbanisation, industrialisation and high-fat diets. There is strong evidence of bacterial species and subspecies that are dramatically and consistently underrepresented in westernised population, and which **pose a global biomedical thread**. Hence, unravelling these microbial ecology dynamics together with the investigation of their effects, is of crucial relevance in the effort to preserve our ancestral microbiome and defend the biodiversity that co-evolved with our body before the westernisation of our diets and lifestyle.
- The microbiomics revolution has recognised the importance of **man-microbes symbiosis in health** and disease. The project Homo.symbiosus is opening a new era of individualised preventive care and novel gut ecology-based therapeutic approaches. It argues for a shift from man-microbes symbiosis to disease-prone man-microbes dysbiosis and assesses the potential of diet alone to promote such a shift.
- Within sustainable agriculture, key questions need further research: Why is the efficiency of a biocontrol agent so variable? How can different therapies be efficiently exploited in a combined way to combat microbial diseases? To help answer these questions, the BacBio project studies the microbial ecology and specifically **bacterial biofilms** as a central axis of two differential but likely interconnected scenarios in plant health: the beneficial interaction of the biocontrol agent Bacillus subtilis, and the non-conventional interaction of the food-borne pathogen Bacillus cereus. Read more about BacBio's and similar projects' findings on the importance of plant health.
- Microbes can cause life-threatening diseases and destroy our food sources. But how microbes acquire and use nutrients is often overlooked in evolutionary studies of pathogenicity, virulence and antibiotic resistance. The project MathModExp addresses this challenge by quantifying how microbial community composition is determined by the metabolism, genetics and physiology of individual players, establishing **principles by which microbial composition affects virulence and antimicrobial resistance.**
- The occurrence of chronic diseases like type-2 diabetes or hypertension has dramatically increased. These conditions are characterised by metabolic inflammation. The FP7 funded ENIGMO project found that a specific type of bacteria plays a central role in regulating the host's energy metabolism. Naturally found in the human digestive tract, A. muciniphila was first identified in 2004 by Prof. Willem de Vos from Wageningen University. The principal investigator of ENIGMO, Professor Cani subsequently found that **the abundance of A. muciniphila had the same beneficial impact of a caloric restriction diet on cardiometabolic risk factors**. He designed a protocol for clinical trials on subjects at risk of developing metabolic disorders and started a pilot study in 2016. Eventually, these studies resulted in Professor Cani and Professor de Vos bringing A. muciniphila to the market with their company Akkermansia.

Read about other ERC projects in the brochure: "Microbiome - Spotlight on ERC projects".

[13] ibid.

7. Healthy, sustainable and personalised nutrition

The burden of malnutrition, climate change, resource scarcity, a growing (ageing) population and urbanisation, and food poverty are major challenges for global and EU food systems. Changes in food production, processing and consumption patterns have contributed to an estimated 800 million people who are undernourished, while 2 billion are affected by micronutrient deficiencies and 2 billion are overweight or obese.[14]

ERC projects are addressing these issues from the medical and clinical fields as well as from public health, socio-economic and behavioural perspectives. They are looking into access to food, the composition of our diets, what may be harmful in them, and how to change our food choices for healthier lifestyles, both at an individual and at a population level.

- Addressing **social inequality** in **diet** and health is a major public health challenge; the socially disadvantaged have the poorest diets and die the youngest. A further cause for concern is that public health interventions may be inadvertently worsening social inequalities in diet. To help address this problem, the PIDS project identifies **public health interventions** that benefit all but are particularly effective in improving the diet of disadvantaged groups as this approach will reduce inequality and be the most effective way of improving overall population health.
- Colours and sweeteners are just two of the most common food additives. Recent findings suggest several additives have harmful effects on human health. Based on a combination of epidemiological studies and in vitro/in vivo tests, the ADDITIVES project reveals individual exposure to **food additives in relation to obesity, cancer, cardiovascular diseases, and mortality** and proposes innovative tools to collect data, including names and brands, on foods and beverages widely consumed.

- Human food consumption habits globally pose a significant threat to public health and ecological sustainability. Awareness of the urgency for large-scale global changes has recently been growing substantially; yet, overcoming **preferences for familiar food flavours** in favour of healthier or more sustainable options remains a major challenge. The OLFLINK project helps addressing this challenge by uncovering processes that link olfactory perception inside and outside the mouth across three levels of investigation thereby discovering key factors that facilitate or hinder acquisition of new flavour preferences. Read more about the project on their website.
- The FOODHABITS project studied individual food choices, in particular **the importance of available foods at home** in childhood in influencing choices of young adults. It also focused on the relevance of temptation and self-control in explaining poor nutritional food choices, as well as the influence of advertising in such behaviours. Read more about the project findings in this article.
- Nowadays we can track the exact movement of individuals, analyse their genetic makeup and predict predisposition to certain diseases. However, we are unable to accurately assess an **individual's dietary intake**, and therefore, to assess the link between diet and disease/health. The A-DIET project addressed this issue with the objective to develop novel strategies for assessment of dietary intake. Read more in the article on the project's findings.

Finally, other projects investigate the links between plant-based diets and cardiometabolic diseases as well as obesity and effort-related motivation.

[14] EC (2020). See also: PES FOOD (2019), International panel of experts on sustainable food systems, Towards a common food policy for the European Union.

8. Food safety systems of the future

Food safety is an underlying element of good health and is crucial for sustainable development. While major improvements have continuously been made, food safety and traceability remain a concern in the EU, with high social and economic costs. Climate change has complex associations with a number of food safety hazards, potentially leading to increased risks of foodborne illnesses and affecting access to safe and nutritious food for millions of people around the globe.[15]

Several ERC projects address these challenges, as they study plant health and foodborne diseases. In the physical science and engineering domains, researchers are also looking into innovative ways to label food products.

- **Bacterial toxins** cause devastating diseases in humans and animals. Cellular strategies used by bacteria to silence toxin production are part of innovative antitoxin and vaccine strategies that can be used by the food, feed, medical and agricultural sectors. The first repressor that blocks the production of the most poisonous substance known to mankind, botulinum neurotoxin (BOT), was discovered by the principal investigator of the whyBOTher project. This toxin kills in nanogram quantities and is produced by the food pathogen, Clostridium botulinum. The project explores how C. botulinum cultures coordinate BOT production, and which genetic and plastic cellular strategies are used to weaken it.
- As a source of innovative applications in the fields of biotechnology, pharmacology, energy storage and the **food industry**, capsules offer tremendous potential. But scientific challenges remain, such as finding the optimal compromise between payload and membrane thickness. The MultiphysMicroCaps project explores the use of deformable liquid-core **capsules of micrometric size to efficiently transport active material**.
- The impact of synthetic organic molecules on health, life quality and lifestyle is beyond doubt. It is therefore of fundamental importance to **detect, quantify and track organic compounds** and provide a precise risk/benefit assessment, before they reach the market and have a large public exposure. This information is critical for pharmaceutical development, crop science and human food safety evaluation. The FASTLabEx project adopts a novel approach for the preparation of carbon-labelled complex organic molecules that introduces the radioactive tag at the ultimate-stage of the synthesis. Its outcomes will have a tangible societal impact not only for the radiochemical community, but also for pharmaceutical and agrochemical industries, and for consumers and patients.

9. Food systems Africa

Africa has the world's fastest growing population, which is foreseen to nearly double by 2050. The market for food in Africa is expanding rapidly, fuelled by urbanisation, growing incomes and an increasing middle class. However, malnourishment in all its forms remains a big challenge. This pathway is in line with several Sustainable Development Goals, most importantly the second goal striving to 'end hunger, achieve food security, improve nutrition, and promote sustainable agriculture'.[16]

- Agriculture plays a central role in developing countries, particularly in Sub-Saharan Africa, encouraging economic growth and employing most of the labour force. However, limited access to input and output markets restricts technological improvements and agricultural productivity. The AGRIMKT project seeks to **improve farmers' access to markets** in East Africa by assessing the impact of contract farming; increasing the demand for crop insurance among small owners, and assessing the impact of land market access on small owners.

[15] EC (2020)
[16] ibid.

- The majority of the global poor live in rural areas and depend on agriculture for their livelihoods. **Linking farmers in developing countries to global markets**, therefore, could potentially spur growth and reduce poverty. The SharingGains project develops policy tools to evaluate existing agricultural policies and design better ones. The project implements the first randomised control trial to test for the causes and consequences of market failures along multiple layers of agricultural value chains; it develops and estimates the first structural model of an agricultural value chain to evaluate different regulatory interventions, and studies voluntary sustainability standards (e.g., Fair Trade, Rainforest Alliance).
- Agriculture-induced deforestation leaves in its path small tropical forest patches, most found across West Africa. Such patches are home to diverse communities of native plants and species, provide critical ecological functions and are important for the livelihoods of local populations. The SUSTAINFORESTS project analyses the interactive **roles of forest patches in the agricultural landscapes** of the rainforest and savannah zones in Togo, Benin, Nigeria and Cameroon. The project will also encourage work towards more sustainable land and forest management practices.
- Across sub-Saharan Africa, animals provide sources of food and income. However, unsustainable hunting practices reduce biodiversity and risk zoonotic disease transmission. Also, the higher level of antimicrobials in food animals drives increased drug resistance. With a particular focus on Sierra Leone and Kenya, the ALIVEAfrica project assesses **the role of animals for contemporary livelihoods** and the implications of human-animal relations for the well-being of multispecies communities. Read more about the project on their website.

10. Food systems and data

Data-driven innovation is reshaping the way we produce, consume, and share food and how it is researched, and there is a sharp increase in the number of smart connected objects. Many of these innovations can contribute to policy ambitions like the EU Green Deal, the Farm to Fork strategy or the common agricultural policy and have the potential to advance the concept of 'food citizenship'.[17]

Several ERC funded projects contribute novel approaches to data and sustainable food production. Moreover, these projects are also advancing the notion of food citizenship.

- Although the human population has quadrupled over the past century, per capita food availability is globally higher than ever - at the expense of the environment. The SOS.aquaterra project tackles this challenge by identifying measures to meet future food demand while staying below water and land scarcity thresholds. It develops novel integrated modelling and data analysis methods to exploit the rapidly increasing global open spatio-temporal datasets together with outputs from global agrological and hydrological models. Another novelty is that it develops an integrated model that combines for the first time the potential of conventional and innovative measures - e.g. yield gap closure, alternative protein sources - towards increased food availability. The innovative integration of measures using the latest datasets and modelling tools significantly advances the scientific and technological state of the art to **meet food demand with sustainably managed natural resources**. Read more about the project on their website.

[17] ibid.

- While not focusing directly on food systems, the SmartForests project is nonetheless worth highlighting as it explores **how forests are becoming "smart"** through the increasing use of digital technologies to manage these environments. Forests are key contributors to the carbon cycle and biodiversity, as well as air and water quality. At the same time, digital technologies are reshaping forests to manage and enhance their environmental contributions. Smart forests span locations from Germany to New York City to Thailand, and from remote to urban areas. The project investigates not only **how digital technologies are remaking forests, but also how forests become social-political technologies for addressing environmental change**.
- Considerable attention goes to 'smart' urban food procurement, with little notice of the cultural diversity within Europe. For a growing urban population, food is a mediator of relations within social networks, not only a commodity or nutrient. Eaters are not just consumers but social actors whose meaning-making depend on faith, gender, age, income, or kinship. How we procure and share food is thus central to cultural understandings of citizenship. This is why the FOOD CITIZENS project studies collective food procurement across European cities, asking if and **how collective food procurement networks indicate emerging forms of 'food citizenship'**. Read more about the project on their website.

In a nutshell

This report outlines the rich diversity of ERC funded projects which are in various ways relevant for the pathways identified in the EU's Food 2030 research and innovation policy, either through the advancement of our understanding of the underlying causes of the sustainability challenges at hand and/or by proposing concrete solutions for overcoming these, as indicated by many of the examples described above. ERC bottom-up, frontier research is thus instrumental for ensuring that we have cutting edge solutions to the pressing issues that society faces but also for strengthening the science-policy interface by providing a solid evidence basis in the form of new knowledge, concepts, data and methodologies.

Further reading

Other reports that offer a mapping of research and innovation actions relevant for the Food 2030 policy include the Food systems: Research and innovation investment gap study by the Directorate-General for Research and Innovation, from March 2023. It presents the results of a comparative study of food systems research and innovation investment levels in the EU, considering public and private R&I spent at both national and EU level.

As mentioned above, the majority of the projects presented in this report are also presented in the factsheet: ERC frontier research contribution to the European Green Deal that gives an overview of the projects relevant for the selected areas of the European Green Deal.

Furthermore, the factsheet published by Directorate-General for Research and Innovation, Research & innovation, Safeguarding food security and reinforcing the resilience of food systems illustrates concrete examples how R&I can help develop and test solutions, overcome barriers and uncover new market opportunities for addressing food security.

European Commission, Directorate-General for Research and Innovation, Lüth, D., Vandrich, J., Fabbri,, Urban food system transformation in the context of Food 2030 – Current practice & outlook towards 2030, Vandrich, J.(editor), Fabbri, K.(editor), Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2777/507125 This report reflects on the future of sustainable food systems in line with the priorities of the Food 2030 initiative. It seeks to share good practices and to serve as inspiration for other urban areas wishing to transform their food systems. The report is based on a survey of 22 European urban food system transformation projects, in-depth interviews, and a participatory workshop with representatives of some 25 European projects and networks.

For more publications linked to the Food 20230 R&I policy, find a more comprehensive list on the dedicated website of the Directorate-General for Research and Innovation: https://research-and-innovation.ec.europa.eu/knowledge-publications-tools-and-data/publications/all-publications/publications-about-food-2030_en#documents

Acknowledgements

We would like to thank the members of the ERCEA Feedback to Policy (F2P) network for their inputs and support and the Agency's scientific officers who were instrumental in selecting projects for this report. We would also like to thank our colleagues in the DG R&I, Unit 2: Science Policy, Advice and Ethics and in Directorate B: Healthy Planet for the excellent collaboration and valuable feedback.

Under the Horizon Europe programme, the European Commission has delegated a new task to the ERC Executive Agency (ERCEA) to identify, analyse and communicate policy relevant research results to Commission services. The ERCEA has developed a **Feedback to Policy (F2P)** framework for ERCEA to guide these activities adapted to the specificities of the ERC as a bottom-up funding programme.

This freport is part of a series aiming to demonstrate the relevance of ERC-funded frontier science, for addressing acute societal, economic and environmental challenges and thus their contributions towards key EU policy goals. This F2P series does not offer any policy recommendations.

More information: https://erc.europa.eu/projects-statistics/mapping-erc-frontier-research

Neither the Agency nor any person acting on behalf of the Agency is responsible for the use that might be made of the following information.

Luxembourg: Publications Office of the European Union, 2023

© European Research Council Executive Agency, 2023

ERCEA's reuse policy is implemented by the Decision of 12 December 2011 - reuse of Commission documents.

Unless otherwise indicated (e.g. in individual copyright notices), content owned by the ERCEA and/or EU on this website is licensed under the Creative Commons Attribution 4.0 International (CC BY 4.0) licence. This means that reuse is allowed, provided appropriate credit is given and changes are indicated.

For any use or reproduction of photos or other material that is not under the EU copyright, permission must be sought directly from the copyright holders.

Pictures: © www.gettyimages.com

PDF: 978-92-9215-122-5 • doi: 10.2828/106806 • JZ-04-23-399-EN-N

Getting in touch with the EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

– by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

– at the following standard number: +32 22999696 or

– by email via: https://europa.eu/european-union/contact_en

Finding information about the EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/bookshop. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

EU law and related documents

For access to legal information from the EU, including all EU law since 1952 in all the official language versions, go to EUR-Lex at: http://eur-lex.europa.eu

Open data from the EU

The EU Open Data Portal (http://data.europa.eu/euodp/en) provides access to datasets from the EU. Data can be downloaded and reused for free, both for commercial and non-commercial purposes.

Contact: ERC-Info@ec.europa.eu
https://erc.europa.eu/

Publications Office
of the European Union