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STRATEGIC RESEARCH & INNOVATION AGENDA FOR ORGANICS AND AGROECOLOGY

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Strategic Research & Innovation Agenda for Organics and Agroecology
Leading the transition to sustainable food and farming in Europe

CONTENTS

INTRODUCTION

Coordinators: Maria Gernert & Yulia Barabanova

TP Organics is one of the 40 European Technology Platforms recognized by the European Commission. Since 2007, TP Organics has been shaping research and innovation agendas to advocate for more sustainable food and farming systems in Europe based on organic and agroecological principles.

The research priorities outlined in this publication are the result of intensive discussions, workshops and consultations that TP Organics held in 2018–2019. The priorities are the reflection of the knowledge and innovation needs of farmers, processors, companies, and civil society groups. They are eager to work with researchers and transform the food and farming systems of Europe.

Our food and farming systems need to be climate-neutral, circular, diverse and fair. They need to be prepared for the rapid digitalisation of our economies, which brings new opportunities but also comes with risks. To achieve this, all actors need to change the way we produce and consume our food. Policy makers have a crucial role to play in this transformation. Their role is to ensure a common, integrated and holistic approach to food policy. An approach that has a long-term vision for the future, harmonizes goals, strategies and actions across sectors[1], prioritizes investment for public goods and engages diverse actors in making this happen.

TP Organics is convinced that research and innovation on organics and agroecology can enable the transition of our food systems towards a more sustainable future for all. The Strategic Research and Innovation Agenda shows concrete research areas and priorities that need to receive proper support at EU level, in particular through Horizon Europe, the European Partnerships and Missions as well as EIP-AGRI, in order to leverage the potential of organics and agroecology.

1 For example, food, agriculture, trade, environment, health, technology etc

THE NEED TO TRANSFORM OUR CURRENT FOOD AND FARMING SYSTEM

Our current food and farming systems are unsustainable and need a profound transformation. Europe is significantly exceeding the planetary boundaries with regards to climate change, nitrogen & phosphorus flows and land-system change[2]. This is largely caused by the way we produce & consume food. The high external costs are not integrated in the price of food but are paid by society at large[3]. In addition, serious health and socio-economic impacts are linked to the current food and agriculture model.

In terms of climate change, agriculture is driving the release of stored carbon into atmospheric CO2. In Europe, agricultural production of food, fuel and fibre accounts for 11.3% of greenhouse gas (GHG) emissions and for 94% of ammonia emissions in the EU that negatively affect air quality[4]. The use of synthetic fertilisers is linked to 50–80% nitrogen load in freshwater bodies in Europe, with adverse effects on water quality and aquatic ecosystems[5].

Food production also exerts pressure on ecosystem services[6]. Agricultural intensification and the use of pesticides is associated with a rapid decline in insects and other species[7]. Furthermore, 970 million tons of soil are lost in Europe annually, and 11% of the EU's territory is affected by soil erosion[8]. The environmental challenges of food and farming in the EU are compounded by the fact that 20% of the food produced is wasted[9].

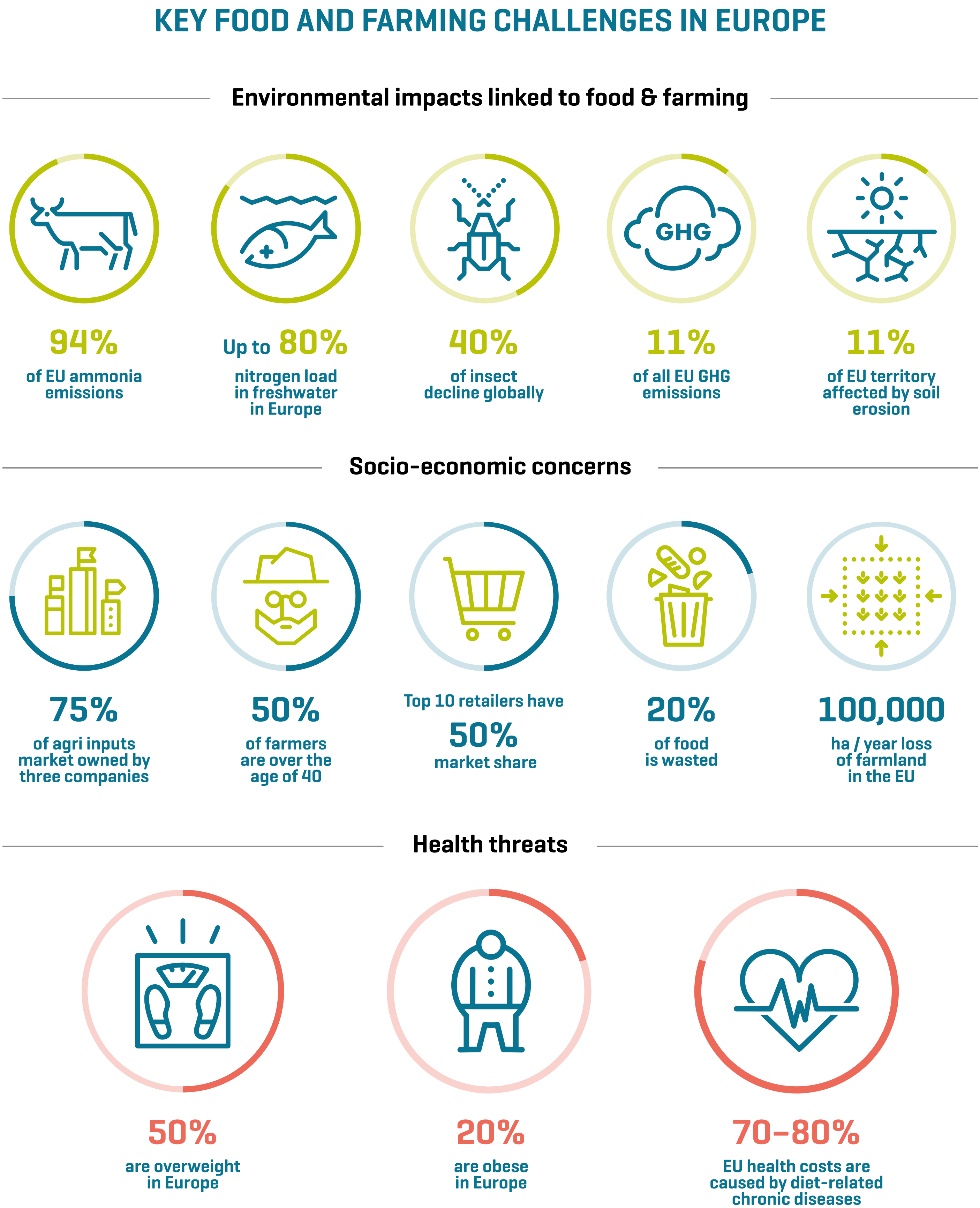
Unsustainable food systems give rise to health and social challenges such as malnutrition and food poverty[10]. In 2016, around 43 million people (9.1% of the EU population) were unable to afford a good quality meal every second day[11]. At the same time, more than half of the European population is overweight and more than 20% are obese.[12]

Chronic diseases, diet-related to poor diet, account for 70–80% of EU healthcare costs[13]. Food systems also impact negatively on human health through environmental contamination such as air pollution, pesticide concentrations in groundwater, exposure to endocrine disruptors and the increase of antimicrobial resistance[14].

From a socio-economic perspective, an increasingly ageing farming population (over 59% of farmers are over the age of 40[15]), the loss of farmland due to urbanisation or industrial development (100,000 ha/year[16]) and the concentration of power in the agrochemical and food sectors are alarming. In the agricultural inputs industry, the "Big Three" companies, Bayer-Monsanto, Corteva and Syngenta-ChemChina, currently own over 75% of the global market[17]. Meanwhile, the top ten retailers have a combined market share of more than 50% which affects the farmgate prices and the ability of producers to invest in innovations[18]. Recent controversies surrounding the use of glyphosate, genetic modification, Bisphenol A and aspartame have led to increasing distrust of European food systems among EU citizens[19] .

Most of the United Nation's 17 Sustainable Development Goals (SDGs) relate in some way to food and farming, and a transition to sustainable and resilient food systems is a crucial prerequisite to achieve these goals. For food production to remain within planetary boundaries, it must move away from the resource-intensive industrial system to one that is grounded in organic and agroecological principles[20].

2 Hoff et al., 2017
3 e.g., IAASTD, 2009; Swinburn et al., 2019; Willett et al., 2019
4 EEA, 2015; EEA, 2017a
5 EEA, 2015
6 Rocha & Jacobs, 2017
7 IPBES, 2019; Hallmann et al., 2017; Sánchez-Bayo & Wyckhuys, 2019
8 Panagos et al., 2015
9 Stenmarck et al., 2016
10 Randelli & Rocchi, 2017
11 EUROSTAT, 2017
12 WHO, 2008;
13 Seychell, 2016
14 Rocha & Jacobs, 2017
15 Eurostat, 2017
16 IPES-Food, 2019
17 Friends of the Earth International, 2019; IPES-Food, 2017
18 EEA, 2017b
19 BEUC, 2018
20 Dooley, 2018



Sources: EEA, 2015, 2017; Sánchez-Bayo & Wyckhuys, 2019; Panagos et al., 2015; IPES-Food, 2017; Eurostat, 2017; Stenmarck et al., 2016; IPES-Food, 2019; WHO, 2008; Seychell, 2016

Figure 1: Key food and farming challenges in Europe

ORGANICS AND AGROECOLOGY AS A RESPONSE TO THE FOOD SYSTEMS CRISIS

Two main approaches are proposed for the transformation: sustainable intensification[21] and scaling up transformative systems like organic agriculture and agroecology.[22] Sustainable intensification relies on technology and productivity-focused solutions to improve resource efficiency and minimize negative impacts[23]. Transformative approaches aim toto redesign the system whilst considering local context and needs. Importantly, they address governance, power dynamics and socio-cultural dimensions of transition[24]. Data show that organic and agroecological systems can compete with industrial agriculture in terms of total outputs[25]. The organic and the agroecology movement is joining forces with like-minded actors to advocate for coherent policies that can drive a transition towards more sustainable food systems[26].

Agroecology, including organic farming, emerged as an alternative to industrialised agricultural systems. Recognised globally (e.g., by the UN's Food and Agriculture Organization (FAO)), these systems prioritise the sustainable use of natural resources and biodiversity conservation and represent a promising solution for the environmental, social and socio-economic challenges facing agriculture[27].

The International Federation of Organic Agriculture Movements (IFOAM) approved health, ecology, fairness and care as Principles of Organic Agriculture[28]. Whilst the definition of agroecology can be applied to various systems, organic food and farming is the only system that is legally recognised in regulations and standards both in the EU and globally. The first European regulation on organic production No 2092/91 came into force in 1993[29]. It defines how agricultural products and foods that are designated as organic must be grown and labelled. Organic food and farming has a longstanding tradition in Europe. The concept is rooted in the social movements of the early the 20th century, mainly in German and English-speaking countries.

In 2017, there were 14.6 million ha organic farmland, almost 400,000 farmers and more than 71,000 processors in 2017[30].

Currently there are around 250 approved control bodies across the EU[31]. Valued at 37.3 billion euros, the European market for organic food is the second largest in the world[32].

Agroecology is an integrated approach that applies ecological processes and social concepts to agricultural production systems. It is at once a science, a movement and a set of[33]. This multidimensional definition maintains open boundaries, allowing agroecology to include different types of farming system, one of which is organic agriculture. Seen as a social movement that promotes the transition to food sovereignty, agroecology is sometimes considered to be synonymous with organic farming and sometimes as a distinct movement and practice[34]. It is important to stress, however, the synergies between agroecological and organic approaches. Together, they have the potential to transform existing food systems fundamentally. Both approaches strive for a systemic transformation of our food and farming and provide a set of overlapping principles to underpin the transition. They promote a "closed" or circular approach, emphasise the importance of soil fertility, maintaining biodiversity and aim to optimise performance by intensifying and building upon natural systems rather than by intensifying external inputs[35]. Both approaches seek to increase the involvement of producers and citizens, to communicate more directly with consumers and to engage with social movements. They are open to learning and continuously improving their practices in line with their principles[36]. Comprehensive, public policy-driven responses and renewed leadership at EU level are required to further support organics and agroecology in order to facilitate the transition to more sustainable food systems[37].

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21 Buckwell et al., 2014; Pretty et al., 2018
22 FAO, 2018b, c; World Future Council, 2018; HLPE, 2019
23 HLPE, 2019
24 Ibid.
25 IPES-Food, 2016
26 Eyhorn et al., 2019; IPES-Food, 2018
27 Eyhorn et al., 2019; Gliessman, 2016; Migliorini et al., 2017; Sanders et al., 2016
28 www.ifoam.bio/en/organic-landmarks/definition-organic-agriculture
29 EEC, 1991
30 Willer & Lernoud, 2019
31 Ibid.
32 Ibid.
33 Wezel et al, 2009
34 IPES-Food, 2019
35 Arbenz, 2018; Bellon et al., 2011; Gliessman, 2016; Migliorini et al., 2017; Niggli, 2015
36 TP Organics, 2017
37 FAO, 2017a, IPES-Food, 2019

VISION FOR FUTURE ORGANIC AND AGROECOLOGICAL RESEARCH

A transformation based on organic and agroecological principles is urgently needed to address the acute challenges brought about by today's input-intensive food system. Sustainable food and farming systems in Europe should be efficient in their use of resources to minimize the inputs and environmental impacts. However, efficiency alone will not help address all the challenges. Agri-food systems should also be based on the logic of sufficiency which allows for reductions in production and consumption, at the same time as sustaining thriving communities. Finally, food systems should be consistent with the existing ecological balance, the carrying capacity of ecosystems and the specific territorial, cultural and socio-economic contexts[38].

To support a transition to such food systems, Research & Innovation (R&I) in the EU needs to focus on:

- Moving organics forward;
- climate resilient, diversified farming systems;
- the redesign of food and agricultural policies from local to EU level;
- sustainable value chains for better food systems.

The following chapters will highlight the R&I priorities within each of these themes.

38 TP Organics, 2017

TP ORGANICS' VISION FOR RESEARCH & INNOVATION TO TRANSFORM FOOD AND FARMING IN EUROPE

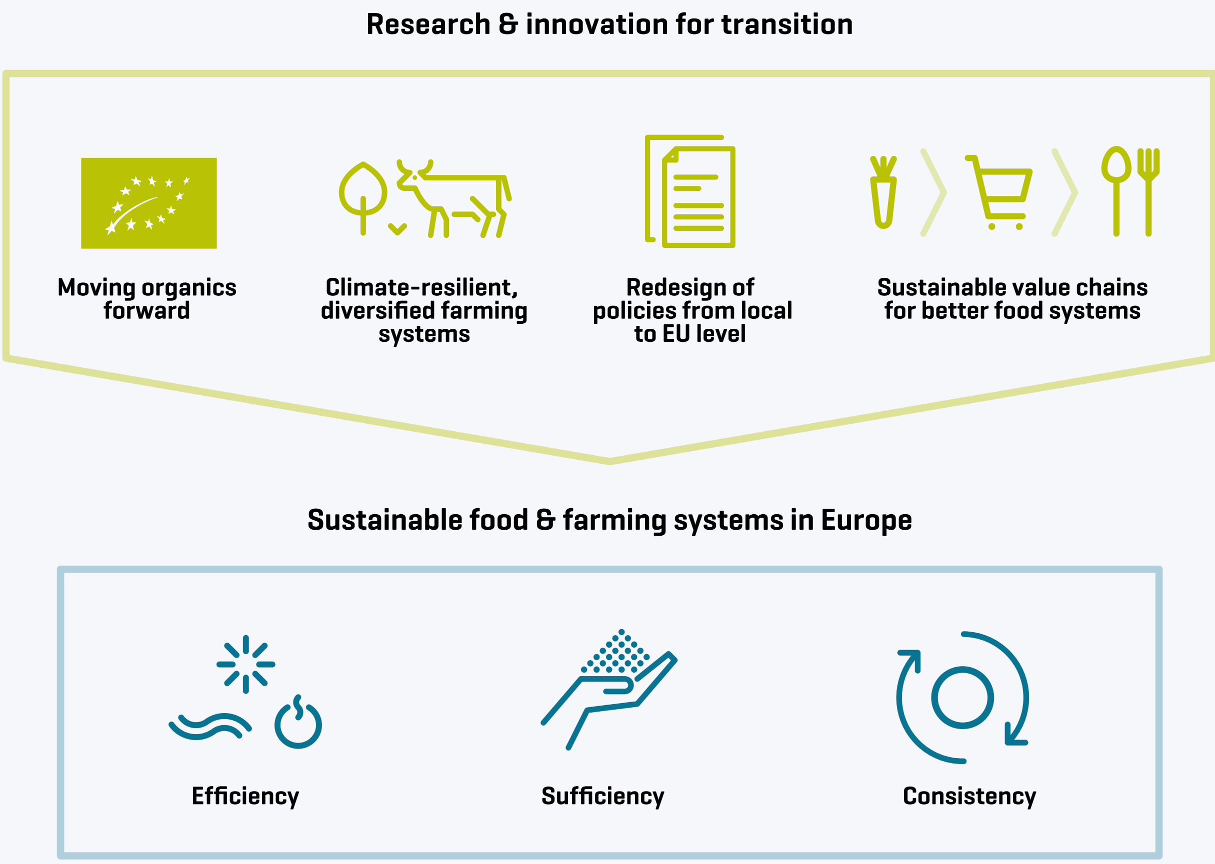

Figure 2: TP Organics' vision for Research & Innovation to transform food and farming in Europe

OUTLOOK ON HORIZON EUROPE

Horizon Europe, the EU's 9th Framework Programme for research and innovation (R&I), will provide an ambitious 100 billion EUR budget for the period 2021–2027. The programme adopts a mission-oriented approach and is expected to have clear goals with specific and measurable targets and defined timeframes. Horizon Europe is based on two legislative texts: The Regulation sets the general framework and rules of participation while the Decision on the Specific Programme defines the content in broad lines[39]. In March and April 2019, the European Parliament and the Council of the EU reached a provisional agreement on Horizon Europe. Following the political agreement, the Commission has begun a strategic planning process. The outcome will be set out in a multiannual Strategic Plan to prepare the content in the work programmes and calls for proposals for the first 4 years of Horizon Europe. The strategic planning will continue until early 2020, and the first work programme is expected by autumn 2020.

Cluster 6 of Horizon Europe, "Food, Bioeconomy, Natural Resources, Agriculture and Environment" should aim at building knowledge and developing innovative solutions that will accelerate the transition to sustainable food and farming systems. Priority should be given to organic and agroecological approaches that use natural resources efficiently and sustainably, create circular systems and reduce soil erosion and pollution of the environment. Organic farming has already demonstrated its potential for climate change mitigation and adaptation. By drawing down carbon from the atmosphere into the soil, organic and agroecological approaches reduce GHG emissions[40]. They contribute to halting the ongoing, rapid biodiversity loss and to restoring ecosystems and their services. TP Organics therefore welcomes the Specific Programme's provisions that Horizon Europe will support organic farming, agroecology and research on the delivery of ecosystem services in agriculture and forestry through applying ecological approaches and testing nature-based solutions at the farm and the landscape level.

Horizon Europe will draw on a mission-oriented approach, setting defined goals, with specific targets and working to achieve them in a set time. The European Council and Parliament have agreed on five Mission Areas. TP Organics welcomes the planned Mission for Soil Health and Food which explicitly includes ecology and agroecology, the delivery of public goods and systems approaches.

39 European Commission, n.d.
40 FAO, 2011

Better protection of soils, the basis of food production, is urgently needed. Research must consider how the findings can be implemented in practice.

The structure of ERA-Nets, Joint Programming Initiatives (JPIs) and all other public-public and public-private partnerships will be simplified. In terms of food & agriculture, Horizon Europe includes two new European Partnerships[41]: "Safe and sustainable food system for people, planet & climate" and "Accelerating farming systems transition: agroecology living labs and research infrastructures to support implementation and upscaling of agro-ecological approaches in primary production, including organic and mixed farming or agroforestry".

The first partnership will prove essential in the transition to sustainable food systems. 99% of Europe's food sector is made up of SMEs[42], yet their participation in R&I remains low. The partnership should be open to all actors in the agri-food chain and engage citizens and civil society organisations. This is especially relevant to dietary shift, including reduced consumption of animal products and the reduction of food waste.

The second partnership on accelerating farming systems transition will be a crucial instrument to support the upscaling of organic farming and agroecology. To be successful, the partnership must build on experiences of previous partnerships, in particular ERA-NET CORE Organic[43] which has already funded research into agroecological processes and organic farming for 15 years. The extensive body of knowledge built by CORE Organic should be integrated in the new partnership. Research into organic farming and agroecology – within and beyond the partnership – should be accompanied by effective advisory services. This requires building closer relationships between advisors and farmers through direct contacts, farm visits and on-farm research.

41 European Commission, 2019a
42 FoodDrink Europe, 2016
43 http://www.coreorganiccofund.org

INNOVATION FOR PUBLIC GOOD

A major concern of TP Organics is that the inclusion of the so-called "Innovation Principle" in Horizon Europe will set a dangerous precedent for policy-making. The Innovation Principle could be used to undermine the Precautionary Principle, and consequently social and environmental protections. This concept was conceived by corporate lobbyists to block and delay key social, health and environmental policies and regulations, ignoring the fact that regulation is a driver of innovation for the benefit of society[44]. Despite several attempts of civil society organisations, including TP Organics, to have the Innovation Principle removed from Horizon Europe, it is still part of both legal texts, the Regulation and the Specific Programme[45].

For innovation to work for the public good, it must not harm public and environmental health. Rather, it must be dedicated to upholding human values and advancing society with real investment in pressing societal challenges including agriculture, food, nutrition and climate change. To do so, innovation must look beyond the quick fixes of a technology to its broader social impact.

To better align the R&I process and its outcomes with the needs, values and expectations of society, TP Organics calls for civil society organisations and EU citizens themselves be engaged in R&I agenda-setting. Organisational, social and knowledge innovations must be promoted alongside technological ones which, on their own, often generate negative externalities. Agri-food innovation is characterised by ecological relationships and social interactions, and should therefore be approached in a systemic, transdisciplinary way. Technologies must be open-source and socio-economically sustainable for farmers. Local adaptions are integral to the innovation process, as are knowledge co-production and sharing, and responsible innovation[46]. In this sense, TP Organics welcomes the fact that Horizon Europe considers the concept of Agricultural Knowledge and Innovation Systems (AKIS) and social innovation to be key drivers that can accelerate the uptake of research findings. This includes the promotion of place-based innovations, reinforcing the multi-actor approach and establishing a network of living-labs in agroecology[47].

44 Corporate Europe Observatory, 2018
45 Corporate Europe Observatory, 2018; Global Health Advocates France, n.d.
46 HLPE, 2019
47 European Commission, 2019a

RESEARCH & INNOVATION PRIORITIES

MOVING ORGANICS FORWARD: PRIORITIES FOR THE ORGANIC SECTOR

Coordinator: Miguel de Porras Acuña

The European Union published the new Organic Farming Regulation (EC/848/2018)[48] in 2018 after one of the longest periods of interinstitutional negotiations recorded in EU history. The longevity of the negotiations reflects the importance and the political weight that organic agriculture has achieved in the agenda of the different European national governments. For four years leading up to the publication of EC/848/2018, the EU organic sector faced a period of uncertainty aiming for a compromise agreement that would support the continued growth that this sector has experienced during recent years. The result of these negotiations among the EU institutions is a political compromise, entering into force in 2021.

The new regulation does not represent a strong shift from the current practices of organic operators in the EU, but introduces many specific rules that the sector will have to comply with: for example, the possibility of trade with heterogeneous plant material for organic farmers, a new equivalence organic trade regime and the possibility of group certification for European operators, among others.

These changes will have implications for organic farmers, processors, retailers, traders, and certification bodies. There are still many open questions as to implementation, especially given that the details of the so-called "second level legislation" are still to be developed. During this period of change it is important to maintain trust of European consumers, as their behaviour will remain an important driver for the future growth of the organic market.

A new regulation calls for new research priorities for the organic sector and support in implementing the changing rules and improving the performance of organic agriculture. This chapter presents some of the most relevant topics identified by organic actors during the process of developing this Strategic Research and Innovation Agenda.

48 Regulation 848/2018: https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=uriserv:OJ.L_.2018.150.01.0001.01.ENG

1 Organic inputs and circular economy: Increasing the circularity of agricultural production

Specific challenge

The European Commission adopted the Circular Economy Action Plan[49] in 2015 which includes the political agenda for the transition of the EU economy towards a more sustainable Europe. This action plan sets ambitious targets to make the economy more resource efficient as well as to develop appropriate incentives for "closing the loop". Despite the importance of the role of agriculture in the use, production and re-cycling of natural resources, little attention has been paid to it from the circular economy sector. On the one hand, many big industrial companies have mastered new methods and technologies of recycling raw materials from different waste streams. Using new extraction methods, in some cases energy and chemical intensive ones, these industrial players claim to be more resource efficient, but their contribution to the reduction of the environmental footprint of agriculture remains unclear. On the other hand, organic agriculture has been developing a "circular" approach to agriculture since its beginnings, applying ecological and recycling/reusing principles to agricultural production. The practices of crop rotations, nutrient recycling and biological fixation of nitrogen through legumes, composting, integrating animal and crop production, and concern for the health of soils have been the circular solutions for closing the loop in agriculture.

This less input-intensive strategy of the organic sector, combining new technologies and methods with scientifically-sound, positive environmental outputs (e.g. bio-digestion, insect production, etc.), has great potential for increasing resource-efficiency not only of the organic sector but of European agriculture as a whole. This potential becomes apparent when addressing the nutrient availability for agriculture[50]. With increasing costs of synthetic fertilizers, and reduced availability of non-renewable resources (e.g. phosphates), the circular approaches for maintaining nutrients in soils are the only strategies available.

Scope

Research should adapt the principles of organic agriculture to the possibilities of the circular economy framework, providing coherent solutions for solving resource scarcity and increasing resource-efficiency of both organic and conventional agriculture. The possibility of scaling up different inputs available for organic agriculture as solutions for EU agriculture in general should be explored. The development of new fertilizers, their production and use (based on compost, bio-digestates, etc.) should be assessed in the light of both the EU organic regulation and organic principles. Special attention needs to be given to the assessment of the use of contentious waste products or critical and scarce resources in agriculture (e.g. sewage sludge). New methods and products that develop more effective natural plant protection products and strategies need to be assessed and scaled-up from organic to mainstream agriculture. Whilst grass and roughage feed (non-edible for humans) play an important role in feeding in particular ruminants, for other species (including fish), other feed inputs (e.g. concentrates, protein feed) and feed additives are required. Better utilization of available by-products and alternative inputs (e.g. feather meal, oil cakes, okra as protein feed for fish, pigs and possibly other animals), could reduce the dependency on imported protein feed and increase the local sufficiency in feed for organic animals. For this reason, integrated animal-plant production systems also need to be developed further to increase their adoption among EU organic and non-organic producers.

Projects also need to consider the socio-economic factors that impact on the adoption of these circular methods by producers, as well as consumer attitudes to these new production methods. The regulatory and political dimension of these new circular products needs to be considered, in order to develop solutions that fit the needs of both organic and non-organic producers.

Expected Impact

- Strategies for the maintenance of long-term soil fertility in organic farming, with better access to nutrients and organic matter in recycled fertilization products are further developed;
- new circular products are developed to allow the phasing out of contentious inputs[51] in organic agriculture and more sustainable alternative substances for mainstream agriculture;
- increased use of recycled inputs (e.g. feed, fertilizers) that are appropriate for organic production;
- increase in the local sufficiency in feed and the connection with the place of organic production;
- better dissemination and better communication to EU consumers and civil society in general on how greater circularity increases the sustainability of organic and non-organic farming;
- clear regulatory guidelines are developed and adopted for the integration of circular products and methods in agriculture preventing unsustainable uses.

49 European Commission, 2019b
50 www.solace-eu.net
51 www.relacs-project.eu

2 European Market Observatory for organic food & farming

Specific challenge

Market transparency in the organic food market remains a challenge, when it comes to collecting, analysing and pooling of data at the European level. This includes electronic data on product volumes and values, product flows in the internal market, estimates of the retail sales markets, import/export data, price data, data on certificates, practices for fraud prevention, and data on contamination in organic farming. There is also very limited information on farm-gate and retail prices, the differences in structure of the supply chains, and on the added value and the farmer share in supply chains[52].

The new organic farming regulation (EC/848/2018) recognises the need for data for the monitoring of the regulation and demands that Member States provide such information to the Commission, drawing as much as possible on established sources of data. Reliable and accessible market data are also an essential requirement for investment decisions of operators who are considering entering the organic sector. The European evaluation of the distribution of the added value of the organic food chain calls for an improvement in the availability of market data at all levels of the supply chains to be a key priority for the future development of the organic sector[53]. In addition, research needs to be carried out that addresses the integrity and reliability of organic certification and control systems including organic imports, in view of rapidly increasing numbers of operators.

On the consumer side, there is a specific need for the pooling of consumer survey data relating to organic markets. A growing number of stakeholders, public and private, conduct market surveys and gather relevant data on consumers, but there is a lack of harmonization of procedures and indicators. Data need to be pooled, exchanged and analysed for an EU-wide market perspective which also identifies changes in trends over time.

Other major challenges arise from the lack of available statistical data as regards agroecological initiatives. The broader meaning of the concept makes it difficult to have strict definitions. However, there is a clear need to gather statistical information about agroecology to understand its scale.

Scope

Research should investigate the state of organic data collection and the availability of data both for policy makers and operators, in the EU and at Member State level. This should include which organisations are engaging in such activities and their funding models. Projects should build on the outcomes of the Organic Data Network[54] and other projects (e.g. LIVESEED[55]) to ensure better design and use of the national databases on the availability of organic seed and transplants. Project activities should include, as a minimum, all data categories identified by the Organic Data Network, such as primary production (area and livestock, production volume and value), prices (farm level, retail), national retail sales volume and value (incl. importance of specific outlets, direct sales and procurement, product categories) and data on international and intra-European trade. Projects should also consider the other farm level data sources (including FADN) and existing surveys on consumer attitudes towards and demand for organic products and cultural preferences (e.g., Agence Bio, Ökobarometer, Eurobarometer). They should develop recommendations for standardisation and broadening of such surveys across the EU (with particular emphasis on new Member States) and EFTA. Projects should focus on improving comparability between surveys, as well as enhancing the impact of their findings through improved access to the results for organic operators and policy makers in all parts of the EU. Better quality data around issues of certification, control and the integrity of the organic sector need to be collected and used for a more reliable and efficient control system and fraud prevention.

There is currently no information on the extent of agroecology initiatives across Europe. As there is also no approved definition of agroecology, methodologies need to be developed to establish indicators and proxy variables in order to understand and identify the scale and scope of such initiatives.

Expected impact

- Increased harmonization and standardization of data collection activities as regards the organic sector at EU level;
- development of an inventory of agroecology initiatives at EU level and initial data gathering on this approach;
- collection of new data and information as regards organic farming production at farm level;
- increased cooperation between public and private data providers at Member State and EU level to foster harmonization of data collection both at farm and consumer level;
- development of policy recommendations to improve efficiency in data collection;
- increased use of statistical data about the organic sector by policy-makers;
- increased data collection for certification and control purposes.

52 Sanders et al., 2016
53 Ibid.
54 www.organicdatanetwork.net
55 www.liveseed.eu

3 Boosting organic breeding and the production of organic cultivars

Specific challenge

To reach 100% use of organic seed of adapted cultivars by 2036 for all crops[56] and in all Member States is an important political goal. The new organic regulation provides new tools, such as the definition of organic heterogeneous material (OHM), and permission to market such materials. In the scope of implementing the new regulation, a temporary experiment for improving the release of organic varieties suited for organic production is also foreseen. These new elements in the organic regulation have significant potential to support increasing levels of biodiversity and greater resilience in the organic sector. The new regulation will also open the door for the revival of traditional and regional crops and breeds. However, it will also pose new problems for adequate and timely upscaling of organic breeding and seed production meeting the demand of fast-growing markets and the challenges of climate change.

In order to capitalize on the new organic regulation and the temporary experiment on organic varieties to start in 2021, it is important that the implementation is accompanied by coordinated European research which includes a broad range of crops taking into account the diversity of the European seed systems. Improving the production and use of organic seed across Europe will require a strong commitment from the public and private sector, novel governance models for breeding, cultivar testing and seed production as well as intensive training of young breeders and entrepreneurs. Increased volume of organic production will make the organic sector more relevant for commercial plant breeders and seed producers.

Scope

Research should support the objectives for organic seed as set out in the regulation (EC/848/2018) and the transformation of the breeding sector. Projects will identify and develop additional governance and financial models to support organic plant breeding. The whole value chain from farmers, processors, traders to consumers should be included in a multi-actor approach, for example, when defining breeding goals for plant breeding. Capacity building and collaboration with existing actors of the breeding and seed business should be strengthened to achieve the requisite breeding gains.

Special emphasis must be put on the scientific and technical training of young farmers, students and breeders. Case studies of innovative engagement of value chain partners in plant and animal breeding should be studied in different socio-cultural contexts to identify key factors of success. Cultivar testing under organic conditions shall be implemented in collaboration with examination committees. The committees should consist of public and private actors from on-farm and on-station networks for pedo-climatic regions. Governance models and common marketing strategies to introduce improved cultivars will be developed as well as seed multiplication and treatment. Seed and root microbiome should be investigated to improve the resilience of cultivars and breeds. Projects will involve several crop categories including fodder and horticultural crops.

Expected impact

- Increased demand for organic seed resulting in new entrepreneurship in rural areas;
- novel value chain partnerships support new breeding initiatives of orphan crops and breeds;
- new organic varieties, organic heterogeneous material and conventional cultivars s are better adapted to organic farming, showing higher resource use efficiency, resilience towards abiotic and biotic stress and yield stability;
- organic farmers benefit from regular breeding gains, processors – from improved product quality and consumers – from diverse, healthy and tasteful food;
- farmers can make an informed choice on newly available cultivars due to coordinated organic cultivar testing;
- with increased marketing of seeds directly between farmers, farmers' knowledge about seed quality and techniques to prevent and treat seedborne diseases and pests with beneficial microorganisms is increased;
- strengthened connections between different actors in the food value chain and more fairness in risk sharing.

56 www.liveseed.eu

4 New genetic engineering technologies and their implications for organic farming

Specific challenge

The organic sector is more and more aware of the importance of plant breeding for the improvement of organic production. The organic sector recognises the need to develop new cultivars of crops and breeds of livestock to adapt genetics to changing requirements caused by biotic and abiotic factors, climate change, as well as expectations of the value chain and consumers.

Organic plant breeding should follow the principles of organic farming, for example respect for the integrity of living organisms (in particular cell integrity), reproductive capacity, respect for crossbreeding boundaries, and reproducibility. Moreover, organic plant breeding also considers the socio-economic impact of patents on seeds and plant breeding material which hinders innovation and the circulation of genetic resources. It promotes seed autonomy for farmers, transparency regarding parental lines and techniques used during the breeding process, and participatory breeding. It also seeks to maintain respect for our genetic heritage and planetary biodiversity by taking a precautionary approach to the changes we make to it. The organic sector acknowledges that innovation should be considered in all its dimensions (technical, economic, societal, cultural, and environmental), and that it can take many forms, and has positive or negative impacts in all these dimensions.

The development of new genetic engineering techniques in plant breeding represents a challenge to the organic sector. In the EU, these methods are currently not permitted in organic farming. However, an exemption or change in the regulatory framework is possible in the future. This will have a high negative impact on the transparency and traceability of the use of genetic engineering techniques. The new gene technologies are controversial among the European public and are currently rejected by the organic sector. At the same time, new gene technologies in plant breeding could potentially contribute to agricultural sustainability when embedded in a comprehensive approach to farming and food production, where plant protection relies on a variety of measures from crop genetic diversity to measures to increase biodiversity at the field and landscape level.

However, ethical values such as freedom of choice and the precautionary principle are crucial in the debate about the acceptance of new technologies in general and, more specifically, in genetics, biology, agriculture and food production. Limited scientific knowledge is available about values and beliefs that are relevant in the organic sector. Therefore, it is necessary to better understand the values, boundaries and principles that shape both plant breeding based on genetic engineering and organic plant breeding.

It is also necessary to ensure that detection methods and strategies are developed to identify products obtained by new genetic engineering techniques and that both the organic sector and the conventional sector have the technical means to identify and avoid the unintentional use of genetic engineering techniques in in their products.

Scope

In order to i) safeguard the integrity of organic food; ii) ensure access to crop genetic resources for organic breeders; iii) safeguard the autonomy of producers with regard to seeds; iv) produce organically meeting the highest consumer expectations, and v) ascertain that value based approaches to plant breeding are in line with agricultural sustainability, research needs to focus on the following:

- Gaining a better understanding of the role of values, principles and aims of organic farmers and breeders when deciding which technologies are compatible with organic production and breeding;
- assessing and quantifying the contribution of seeds of different provenance to the sustainability and resilience of organic farms;
- comparing the efficiency of different breeding approaches for organic farming;
- developing detection methods and strategies to identify products obtained by new genetic engineering techniques;
- identifying the current market authorisation of plants and animals associated with new genetic engineering methods.

Expected impact

- Furthering the understanding among stakeholders and supporting constructive debates based on scientific findings and ethical values;
- development of solutions to address possible contradictions between values and technological developments;
- strategies and recommendations for the organic sector to address the possible marketing and release into the environment of new genetic engineering techniques;
- assessing the potential contribution to sustainability of new gene technologies in a comprehensive farming system;
- identifying the potential to adjust existing and new technologies and to develop innovations in line with organic values and principles or with societal expectations, instead of technology driven innovations.
- detection tools for genetic engineering techniques that complement traceability available for the whole food production sector.

5 Dealing with contamination in organic products

Specific challenge

Pollution is increasingly a problem in the EU. A huge variety of synthetic substances of agricultural and other origin are present in the environment where they pollute natural resources as well as agricultural crops. This is particularly evident in organic farming, where synthetic pesticides may not be used, but traces can sometimes be found[57]. This poses multiple challenges for the organic sector: (1) Minimizing the levels of contamination of organic products is essential to maintain consumer trust in organic food. Organic farming must, therefore, develop methods for minimizing contamination, for example, hedgerows between conventional and organic fields. Such methods must be implemented by individual organic operators and can entail substantial extra costs. Planting hedgerows, for example, can result in loss of productive land, require labour for maintenance and shading of the crop can cause problems such as uneven ripening and disease; (2) the presence of unauthorized substances in organic production requires investigating by control bodies and operators. Not only does this incur labour and analytical costs to the individual operator, it can also delivery of the commodity, which in turn may affect the entire downstream supply chain. The non-harmonized approach of different EU Member States poses additional difficulties when organic food is traded internationally. According to the new organic Regulation (Art 29 of EC/848/2018) the EU Commission will report on the presence of non-authorized substances in organic products and on how national rules are applied in response to such incidents.

Scope

Research should focus on the identification of critical contamination points of organic agricultural products along the whole organic supply chain (including transport, storage facilities, etc.) with the aim of increasing the understanding of the main sources and extent of contamination by non-authorized substances. These projects should also identify and develop effective and efficient methods and practices for the reduction of the contamination of products with these substances. This should include how different landscape elements influence contamination patterns both positively and negatively, in order to inform farmers about better landscape management to avoid contamination problems. Focus needs to be on the responsibility along all stages of the supply chain, with proposals for effective methods to manage it by properly identifying the sources of the contamination as well as mitigating the negative impacts on organic farmers. For this it is also needed to increase the understanding of the origin of contamination and, in cases of intentional use of non-allowed substances.

Research should aim to develop better guidance for the organic sector on how to deal with contamination, leading to greater international harmonization in this area. Increased efforts on data sharing among all the relevant stakeholders (retailers, importers, control bodies, etc.) are needed to allow for a more coordinated approach to the sources of contamination. The regulatory implications of the findings should be carefully considered to ensure effective communication with policymakers to develop informed political decisions in this area (the authorization of new synthetic substances, establishment of thresholds, etc.).

Expected Impact

- Reduced contamination of the EU organic agri-food chain. This also avoids unnecessary financial hardship for organic producers affected by contamination through no fault of their own;
- greater trust in EU organic food among consumers. This in turn promotes organic farming, thereby reduces the environmental impact of agriculture;
- improved handling of residue cases by Control Bodies, retailers, processors, etc. and increased the communication of data to other public and private stakeholders;
- the agri-food industry as a whole benefits from reduced contamination within agri-food chains.

57 European Food Safety Authority, 2018

6 The implementation of the new organic trade system

Specific challenge

The changes in the organic trade system proposed in the new organic Regulation (EC/848/2018) will be applicable for the international trade of organic products and to organic farmers from third countries. The new system for imports of organic products and proposal for implementation already under discussion establishes two imports regimes based on equivalence or compliance, depending on the third country where the organic good has been produced.

The equivalence system will maintain current equivalence agreements (currently with 13 non-EU countries) that will have to be renegotiated in the frameworks of EU bilateral trade agreements. For countries without this equivalence recognition, only control bodies recognized by the EU can certify organic products for export to the EU. In these countries, after a 5-year transition period when the new regulation enters into force, farmers will have to comply fully with the EU regulation. This change will affect organic farmers located in third countries that are not likely to have a trade agreement with the EU.

Scope

Research should focus on assessing the impact that the implementation of the compliance system will have on existing organic trade flows. An understanding of how these regulatory changes impact on the behaviour of non-EU-equivalent third countries farmers as well as on the behaviour of other actors in the organic supply chain (including control bodies, importers and retailers) is vital. Special attention should be paid to the impact on certification costs for farmers in these countries as well as the dynamics of the organic certification market, including competition with other relevant global organic standards, for example the US National Organic Program (NOP).

It is also important to understand the impact that any changes to organic trade have on domestic (EU) organic production. Special attention should be given to the EU's Outermost regions where agri-environmental conditions might create new opportunities for EU farmers. Proposals should have a strong focus on the analysis of existing statistical data[58] on trade flows and how they link to the dynamics of the domestic organic sector. Research also needs to provide recommendations for policy-makers to develop a power-balanced structure in the design of organic trade policies, regulations and agreements which support the democratization of access to markets.

Expected impact

- A better understanding of
  - the organic trade flows to the EU organic market;
  - the impact on EU organic farmers' decision making;
  - the potential for the regulation to influence current investments and trade flows between the EU and third countries;
- continued availability of organic products (including those produced outside the EU) in sufficient quantities to serve the growing demand of EU consumers;
- increased awareness of European consumers about the impact that organic certified production can have on third countries, as well as more information about the origin of the organic products;
- better understanding of how the rules codified in the new EU organic regulation interact with diverse institutional settings of third countries and how it impacts the production trends of the organic sector at a global level;
- more information about the certification sector, including the financial implications of the new regulation;
- understanding of the competition between organic standards globally and the power relations between them.

58 European Commission, 2019c

7 Increasing the sustainability of organic aquaculture

Specific challenge

Producing enough sustainable seafood protein is one of the important challenges of our food systems, especially considering the stagnation of fisheries production. Organic and sustainable aquaculture play an important role in meeting the rising demand for seafood, but at the same time there is a need to reduce pressure on, and thus preserve, marine resources (e.g. fish meal and oil). This shift needs to be managed sustainably, both ecologically and economically, avoiding a shift to unsustainable production systems. Increasing aquaculture production in a sustainable way requires increased availability of high quality and nutritious feeds which use ingredients other than fish meal and oil and which are not competing with food sources for human consumption (e.g. soybeans). Closing nutrient cycles can facilitate the sourcing of novel feed ingredients (e.g. duckweed, macro-algae or insects) and simultaneously recycle nitrogen and phosphorous emissions into sustainable protein. European consumer demand for fish and shellfish is focused on a limited variety of often highly processed products derived from only a limited range of species. Providing incentives for producers and encouraging consumers to consider more sustainably produced species from polyculture systems can reduce the ecological impact of fish and shellfish production considerably.

There is a lack of availability of organic juveniles for several key farmed species, for a variety of reasons which are mostly species-specific. This hinders the development of several species and creates the additional challenge that it completely prevents the EU-certified organic production of certain species, such as pangasius.

Scope

Research should include strategies on how to increase sustainable alternatives to fish meal and oil, without utilizing marine sourced feed ingredients or those competing with human nutrition. Proposals should aim to develop alternative and truly sustainable feed ingredients for organic aquaculture, including from waste nutrients. The waste nutrients need to be assessed for safety regarding pathogens or contaminants (e.g. heavy metal) and their potential for the recycling of nutrients into high quality feed, especially nitrogen and phosphorous. Closing nutrient cycles can also be achieved by adopting and improving existing multi trophic species systems which have, especially in Europe, only been implemented on a limited scale.

Proposals should also address the specific challenge of organic juvenile availability, focusing not only on species produced in Europe, but also on imported species of high economic importance.

The reasons why different stakeholders (e.g. industry, policy makers, consumers) do not adopt environmentally friendly production systems in Europe need to be scrutinized and strategies developed to address them accordingly. Proposals are not limited to either marine or freshwater production.

Expected impact

- Increased uptake of polyculture and integrated trophic production systems in EU aquaculture;
- increased availability of sustainable feeds for aquaculture produced with waste nutrients at the same time as meeting the nutritional needs;
- further development of organic juvenile production initiatives to meet production needs;
- increased diversification of seafood consumption and a revaluing of local and underused species raising their profile among consumers.

PRIORITIES TO TRANSFORM EUROPE'S FOOD & FARMING SYSTEMS

1 Climate-resilient, diversified farming systems based on ecological approaches

Coordinators: Lizzie Melby Jespersen

Research on and development of climate resilient, diversified farming systems are a prerequisite for more sustainable agriculture that can contribute to the UN's SDGs, mitigate climate change and improve biodiversity in rural areas. Diversified farming systems are here defined as farming practices and landscapes that intentionally include functional biodiversity at multiple spatial and/or temporal scales in order to maintain ecosystem services that provide critical inputs to agriculture, such as soil fertility, pest and disease control, water use efficiency, and pollination. At the same time, they should contribute to public goods such as carbon sequestration, renewable energy, animal and human health and welfare, protection of the environment, biodiversity and rural development.

The research topics in this section focus on four key themes: priorities for crops and livestock production, genetic resources, specialized systems, and climate change adaptation and mitigation.

Diverse and healthy crops and livestock for multi-purpose production

1.1 Achieving a circular economy in livestock production

This topic was developed together with the Animal Task Force[59].

Specific challenge

In the scope of the finite natural resources of the world, there is a clear need to change animal production, the production of animal feed and their impact on the use of natural resources. Therefore, livestock-production systems need to be based on sustainable and efficient ecological cycles and the concept of the circular economy which is a key principle in organic agriculture. Reintegrating livestock and crop production are key elements in this. The circular economy approach to livestock production will include synergy and complementarity with sectors such as crop production and environmental protection, energy supply, food processing, and human and animal health and welfare.

Scope

Projects will address the following key research issues:

- Out-door systems integrating pastures, crops, agroforestry and livestock (monogastrics and ruminants);
- mixed animal production systems integrating different species or different production types within animal species (e.g. combine beef and diary, or eggs and poultry meat);
- reintegration of livestock production systems with specialized cropping systems at farm, local or regional level.

Projects will also contribute to improving the use of by-products and waste products from the feed and food chain as animal feed. Key research issues to address are:

- Biorefinery of by-products and waste products in order to optimize the use of different plant parts like protein, specific amino acids, fibres, minerals and other valuable fractions (bioactive compounds) for feed, food, bioenergy and other biomaterials;
- use of green algae and duckweed as biomass or feed to recover nutrients from water beds;
- assessment of the nutritional value of other by-products, using livestock's ability to use a diversity of crops and biomass;
- analysis of feed interaction in relation to animal phenotypes and animal gut microbiome.

Expected impact

- Better closed nutrient cycles and re-integration of livestock and crop production;
- improved use of resources, reduction of waste and emissions associated with livestock production;
- improved resilience of production systems through mitigated effects of climate change;
- improved efficiency of farm operations and animal production systems;
- more diversified and attractive landscapes in livestock production areas.

59 www.animaltaskforce.eu

1.2 Healthy crops and stable yields – crop management based on functional diversity

Specific challenge

A major reason for the reduced yields in organic crop production is the lack of suitable and effective crop management strategies based on preventive measures such as functional biodiversity and biological control. Weed competition also accounts for considerable yield losses in many crops highlighting the need for effective weed control strategies. Crops with a good nutrient status are more competitive against weeds and more resistant to pests and diseases. Building soil fertility and optimal nutrient management are, therefore, key to achieve healthy crops and stable yields.

Scope

Research should investigate how crop health can benefit from more diverse cropping systems, including grain legumes, cereals, oil seed and protein crops, horticultural and tuber crops. New intercropping combinations, relay cropping, variety mixtures and use of cover crops should also be explored. Novel, more selective and environmentally friendly methods and products to control diseases and pests need to be developed and evaluated. There are serious pests and diseases that need innovative solutions, for example broad bean weevil in fava beans, late blight in potatoes, rust species in cereals, pollen beetles in oil seed rape as well as several diseases and pests in horticultural and plant nursery crops. Solutions for effective biological control are needed at field level, farm level and in the wider landscape to support diversity and abundance of natural enemies, for example tailored flower strips, hedges, tree and bush rows between fields and push-pull techniques. Projects should develop new techniques, equipment, tillage strategies and crop rotation systems for efficient and effective non-chemical weed control, especially in stockless arable and horticultural farming systems. Optimal nutrient availability as regards amounts and timing in relation to crop needs is important for the crop health and stable yields, for which reason projects including nutritional as well as crop protection aspects are encouraged.

Expected impact

- Resource efficient cultivation of crops, including protein crops and new crop species for an extended variety of food products;
- increased production and improved quality of protein food and feed crops in Europe;
- increased yields and yield stability due to better control of pests, diseases and weeds;
- increased competitiveness and economic viability of organic and agroecological producers;
- increased use of sustainable crop management measures in European farming systems, reducing dependence on pesticides;
- increased biodiversity at field and farm level.

1.3 Microbiome and sustainable food production

Specific challenge

To achieve more sustainable farming systems and reduce use of external inputs plant-associated microbiome needs to be better understood. Plants harbour a wide variety of microorganisms both above- and below-ground, which significantly contribute to stability, resilience and adaptability of farming systems via enhanced plant nutrition and resistance against biotic and abiotic stresses. However, farmers and breeders do not have access to the proper tools to make good use of beneficial plant-microbe interactions. Next-generation molecular techniques provide opportunities to make better use of beneficial interactions between the crops and their microbial communities.

Scope

Projects will analyse and assess solutions for the manipulation of the plant and seed microbiomes to make advances in the following areas:

- Use of plant-pathogen-microbiome interactions to predict stress resistance in legume breeding programmes;
- use of plant-plant-microbiome interactions to predict performance of legume-cereal mixed cropping systems;
- augment plant and seed microbiomes via management practices, organic amendments such as compost, bio-stimulants and biological control agents to increase nutrient utilisation and resilience against biotic and abiotic stresses in legumes, cereals and tubers.

Expected impact

- Practical guidelines and decision support tools to capitalise on plant-microbiome interactions;
- novel breeding approaches, resistance assays and selection tools to select crops for improved resilience against biotic and abiotic stresses;
- advanced disease control mediated by the plant-microbiome leading to zero-pesticide agriculture;
- better understanding of the impacts of agricultural management practices on microbiome related crop performance, soil fertility and ecosystem services.

1.4 Digitalisation for more diversified farming systems

Specific challenge

Farming is a labour-intensive economic activity. High labour costs or even lack of labour forces is a barrier to the productivity of farming. Robots and digital applications can help to improve production. Completely new methods and techniques are now available. If these techniques are evaluated and adapted to organic agriculture and agroecology, overall effectiveness and sustainability of the systems improves.

The biggest cost factor in organic crop and vegetable farming is weed control. Whereas many possibilities exist to control weeds between the rows, in some crops, up to 200 working hours per hectare are still spent within the rows. Research & innovation is needed to develop the potential of weeding robots beyond currently existing models. Digital technologies can further be used to plan and locate management interventions with precision. Flower strips and green corridors for instance are important for biodiversity. Yet, they are often considered as economically inefficient. In livestock management, better monitoring of animals, especially with regards to their behaviour and health can lead to improved production sustainability, for example by feeding the right amount at the right time.

Scope

Research should contribute to increasing productivity of (organic) farming through digital solutions. The following solutions may be considered:

- Evaluation of tools such as GPS controlled digital cross hoes or autonomous weeding robots, which can distinguish weeds from cultivated plants. These technologies need to be adapted to organic and small-scale systems;
- real-time monitoring of the status of crops and livestock and in-field diagnostics including pest and disease outbreaks, e.g. using sensors, molecular technology, drones, and cameras., so that effective management decisions can be taken;
- reduction of soil compaction through controlled traffic farming (CTF), a management system that limits all machine loads to a minimum of permanent lanes. In those lanes, erosion prevention, host plants for pest predators, flower strips and other interventions can lead to new designs of crop production;
- precision sowing to integrate biodiverse, green corridors into farming fields. With GPS, cover and catch crops can be planted before the main crop is sown and flower strips can be integrated into an existing field or planted before the main crop is sown. Introduction of sensor networks (e.g. measuring insect numbers and species) and community science to monitor and foster biodiversity;
- multi-actor development of technology for the early detection of diseases indoors using sensors both for crop storage and livestock;
- multi-actor development of methods for more effective water management to increase water use efficiency and to reduce diffuse pollution.

Projects should follow a multi-actor approach to ensure that robots and autonomous systems are developed that meet the needs of farmers. Special attention should be paid to adapt systems to organic farms and agroecological systems of various sizes and a diversity of crops and animals.

Expected impact

Specific ways in which digitalising farming can produce impact include:

- Increased biodiversity due to more diversified fields;
- improved control of pests and diseases;
- reduction of soil compaction;
- better energy, water and other resource efficiency;
- improved health and welfare of animals as well as improved feeding methods;
- increased conversion to organic farming due to reduced labour needs.

Autonomy in genetic resources

1.5 Plant breeding for climate resilience, production stability and income robustness in organic farming systems

Specific challenge

Organic farming in the EU faces a challenge because crop yields per hectare are usually lower than in conventional farming. Breeding better cultivars is one part of the solution to improve production in organic farming. In addition, climate change challenges organic breeders to develop better adapted and more resilient varieties. There is a need for further development and testing of new varieties, population breeding (CCPs), line/variety mixtures for intercropping, building on the results of past and current EU research projects, such as LIVESEED[60] and ReMIX[61]. Moreover, little is known about the influence of the plant-soil microbiota interactions on yield, quality, plant health and resilience in agriculture.

Scope

Key areas in breeding new plant varieties and plant population mixtures for organic agriculture include:

- Breeding to close the yield gap between organic and non-organic agriculture and improve yield stability, by developing varieties bred and/or tested under diverse organic growing conditions;
- breeding for nutritional quality in key crops;
- adaptation of variety types towards more functional biodiversity (e.g. population/CCP/multi-line breeding) in different rotation systems relevant for arable farming, horticulture, orchards and greenhouse cultivation;
- testing of hitherto underutilised crops to understand their potential benefits under different climatic conditions and potential adaptation potential;
- breeding for adaptation to intercropping systems (e.g., adapted plant architecture, interaction with other crop(s));
- breeding for suppression of weeds in monoculture or intercropping systems in different crop rotation systems under different climatic, geographic and soil conditions;
- breeding for climate change adaptation (heat, drought, temporal flooding, salinity);
- breeding for genetic plasticity to nutrient availability under low-input conditions;
- breeding for broad resistance to pests and diseases, either through genetic resistance, improved plant robustness or by biological defence methods (volatiles, plant morphology, plant microbiome etc.).

In order to ensure use of more diverse varieties (and their end products), the entire value chain needs to be involved and the regulatory obstacles for their use need to be identified and resolved. Participatory breeding programmes could increase both research effort, dissemination and on-farm impact. Attention should also be paid to applicability in small scale farms, as both problems and solutions on various scales of operation vary considerably.

Expected impact

- Improved and more stable yields and quality of organic crops;
- increased use of new plant varieties adapted to organic farming systems;
- improved functional biodiversity in fields and intercropping systems;
- improved competitiveness against weeds facilitating organic cropping systems also under higher weed pressure conditions;
- improved climate resilience and nutrient plasticity of crops;
- improved crop health by either improved genetic resistance, plant robustness or enabled biological defence;
- improved economic resilience of organic cropping systems, and with that socio-economic resilience of rural areas throughout the EU;
- improved market acceptance and use of more genetically diverse foods and food products;
- reduction of regulatory barriers to the marketing of more diverse foods and food products, and the seed material for the crops to produce these.

60 www.liveseed.eu
61 www.remix-intercrops.eu

1.6 Breeding of animals for longevity, hardiness, and multi-purpose production

Specific challenge

Until recently, most farm animals used in organic farming in the EU originated from conventional breeding companies, which use techniques and housing systems that are prohibited in organic farming. Conventional breeding goals and methods are not in line with organic principles and continual selective breeding of animals for maximum yields of milk, eggs and/or meat results in animals that are not necessarily robust or suited for climate resilient, low input and diversified farming systems. The practice of slaughtering new-born male dairy calves and newly hatched male chickens of laying hens is against both organic principles and ethical production methods. Similarly, in organic pig production, modern breeds produce too many piglets for the sow to feed resulting in high piglet mortality.

There is an urgent need for the breeding of more robust, climate resilient animals which require less high-quality protein feed, and which may be used for multiple purposes (e.g. milk and meat or eggs and meat). Breeds are needed that can live good quality, healthy lives on the farm.

Scope

Research should investigate relevant dairy and beef cattle breeds as well as laying hen and broiler breeds and map their genotypes as regards the traits that are valuable in climate resilient organic farming systems. These could include roughage utilisation and feed conversion efficiency, growth, health and longevity, temperament, milk and meat yield and quality for cattle and egg and meat yield and quality for laying hens and broilers respectively. Hardiness and easy birth/natural breeding are other important traits that are important for cows, pigs and poultry and therefore old breeds should also be genetically mapped and used for improvement of these aspects. For pigs the number of piglets born, and piglet mortality are important breeding goals. Since different breeds of dairy cows produce different amounts of methane, low methane exhalation should also be considered as a breeding goal in ruminant breeding.

Based on the development of breeding goals for different types of organic animals and the results of gene mapping, new promising breeding programmes for ruminants (cattle, sheep and goats) and monogastrics (pigs, poultry and rabbits) should be designed and tested by means of participatory and multi-actor research involving farmers, advisors, breeders and researchers, as well as by means of modelling. Breeding for dual purposes should also be considered. Requirements in terms of uniformity of animals for slaughtering (especially poultry) may be a challenge, for which reason representatives from the slaughterhouse industry should be involved for development of more flexible processing systems. Research should also include an assessment of the animal health and welfare improvements as well as the delivery of public goods (environment, biodiversity and reduced greenhouse gas emissions).

Expected impact

- Development of breeding goals for ruminants and monogastrics in line with organic principles;
- inventories on relevant genetic traits in relevant breeds including old breeds for use in organic/low input breeding programmes;
- development of breeding programmes for organic dual-purpose cattle and poultry production;
- development of breeding programmes for organic low-input and outdoor pig production with lower piglet mortality;
- development of more robust breeds with longer life expectancy which contribute less to greenhouse gas emissions, which grow well on lower grade feed products such as roughage and grass and which produce high quality animal products;
- better health and animal welfare of organic animals and lower mortality rates for calves, piglets and chickens.

How to ensure production diversity in specialised systems

1.7 Agroecological management of protected cropping and greenhouse production

Specific challenge

Demand for a diverse and stable supply of organic vegetables all year round is rising. Some vegetables need to be grown in greenhouses, at least part of the year, but greenhouse production is energy intensive, especially in northern Europe, and the yield gap compared to conventional production is considerable. Organic protected cropping or greenhouse cultivation is often carried out in monoculture running the risk of disease and pest development as well as nutrient imbalances resulting in suboptimal growth and/or nutrient leaching.

A particular problem in some Nordic countries is the expected end to growing crops in demarcated beds. Demarcated beds will only be allowed for existing and certified demarcated bed- operations for ten years after the organic regulation (EC 2018/848) enters into force in 2021. This is a challenge because soil temperatures may be too cold which slows down mineralisation of nutrients and reduces nutrient availability for the crops. New nutrient management strategies and/or energy efficient soil heating methods are needed to overcome this problem.

There is a need for more diversified cropping systems and agroecological management methods in organic production to increase yield stability, product quality, biodiversity, soil health and improved use of resources, e.g. better rotation systems, use of companion crops and cover crops.

Scope

Based on the recommendations of the COST Action "FA1105 – Towards a sustainable and productive EU organic greenhouse horticulture", projects should investigate financially feasible, new and/or improved management methods and technical solutions to reduce the consumption of energy for heating and CO2 enrichment of the atmosphere as well as more efficient use and recycling of inputs (fertilisers, organic matter, soil, water and peat) in organic protected cropping systems, particularly in heated greenhouses and foil tunnels, to increase crop yields and product quality[62].

Research should also be carried out to evaluate the resource consumption, environment and climate impact of greenhouse systems "growing in the soil" compared to growing in compost beds – especially in the northern European countries. This should be supplemented with an environment and climate assessment of local production in northern Europe compared to imports from the southern Europe. Diversified protected cropping systems should be developed, involving crop rotations, intercropping, cover crops, green manuring and other agroecological methods to improve the functional diversity and competitiveness of the crops against weeds and to increase their pest and disease resistance.

A better environment for pest predators needs to be promoted. Effective and selective biological crop protection agents and organisms need to be developed to complement the preventive measures. Special attention should be given to improving soil health and fertility as well as reducing soil borne diseases. New methods and management strategies to reduce/avoid leaching of nutrients to ground or surface water are also important. The project should be carried out as a multi-actor approach with the participation of organic producers in different types of protected cropping systems under different climatic conditions.

Expected impact

- Economically feasible and energy efficient organic greenhouse/foil tunnel systems to reduce climate change impacts;
- improved crop composition, crop rotation and use of cover crops and green manures to encourage higher and more stable yields of high-quality vegetable products, improved functional biodiversity and weed competition and reduced disease and pest damage;
- better fertiliser, water and soil management, giving rise to better soil health and fertility and reduced nutrient leaching;
- recommendations on greenhouse production in "demarcated bed systems" compared to "growing in the soil systems" in northern Europe.
- recommendations on local greenhouse production compared to imports from southern Europe as regards energy consumption, environment, climate effect, labour, environment, product quality and costs;
- recommendations to producers on climate friendly diversified protected cropping systems.

62 COST Association, 2019

1.8 Diversified fruit orchards and vineyards for functional intensification

Specific challenge

Organic orchards and vineyards are intensive and specialized systems. Although being managed organically means there is some positive impact on biodiversity, these systems are still simplified and often have only one variety (and one rootstock) over large areas or even a single clone (vineyards). Such simplified systems are easily attacked by pests and diseases and the organic management is often restricted to direct control, while the use of agroecological measures is limited, and when applied, often of limited effect. Increasing biodiversity by intercropping is a challenge in such simple systems but could help overcome the need for high inputs in terms of labour, plant protection and soil management and could stabilise yields and product quality in the long term. The challenge posed by climate change requires the development of innovative management strategies for diversified organic fruit orchards. Developing economically viable systems that ensure high quality fruit production involves identification of the best combinations of species and of varieties adapted to the different regions of the EU. Finally, despite several EU projects over the years, alternatives for copper to fight various fungal diseases in fruit crops are still limited. Research into alternative inputs and/or new management strategies and machinery is still urgently needed.

Scope

Research should focus on identifying systems and designs for the inclusion of different plant species within specialized orchards and vineyards. As regions within the EU differ, this development should be conducted in different climatic zones and adapted to various socioeconomic farming structures and cropping systems in a multi-actor approach. Special attention should be given to the inclusion of varieties producing high quality fruit which meets consumer demand. Moreover, projects should quantify the benefits of the diversification, in terms of functional biodiversity, resilience, use of natural resources, pest and disease management, and assess the economic performance of the proposed diversified systems.

Expected impact

- More resilient production systems for orchards and vineyards with enhanced ecosystem services;
- reduced use of contentious inputs in organic orchards and vineyards;
- higher yield stability and improved economic viability of organic orchards and vineyards;
- more efficient production of organic high-quality fruit;
- increase in organic orchard and vineyard cultivation, adapted to different climatic zones of the EU.

1.9 Sustainable concepts for organic and low input monogastric systems

This topic was developed together with the Animal Task Force[63].

Specific challenge

Production systems with monogastric animals are mostly reliant on high quality feeds from external sources that compete with food for human consumption. Especially in the case of monogastrics, livestock production systems have become highly specialised and have become decoupled from other areas of farming. These systems prioritise high yields rather than low environmental impact, resilience and sustainability. This conflicts with consumer expectations about animal production systems. A particular challenge is to create systems which overcome an apparent contradiction between animal welfare and "naturalness" on one hand, and feed and resource efficiency, on the other.

Scope

The position of monogastric animals in organic or low-input animal husbandry must be scrutinized. Specific emphasis is needed to reconcile "naturalness" of animal husbandry with resource efficiency. This may require addressing conflicts between feeding and husbandry strategies on the one hand and market expectations on the other hand by reassessing industry quality standards. Systems could be developed and evaluated in which animals are kept in more natural environments, to achieve better animal welfare and health, while at the same time avoiding ecological side-effects like groundwater eutrophication. Management and stocking density are crucial in this respect. Projects should deal with the challenge of how to allow for natural animal behaviour and ensure part of their nutritional needs with natural vegetation. New methods of recycling nutrients into feeds (e.g. via duckweed or insects) need to be adapted to organic farming and low-input systems. Integrated systems of plant and animal production will lead to higher biodiversity (e.g., poultry in fruit orchards). This potential needs to be further explored in terms of impacts on biodiversity and successful husbandry and management measures.

Expected impact

- Reduced environmental impact through environmentally friendly husbandry and management systems;
- better balanced animal production, resolving the current disconnection between feed, animals and animal products;
- better landscapes through animals housed in natural environments;
- improved robustness of monogastrics and high animal health and welfare standards in more appropriate production systems;
- improved producer and consumer awareness in terms of the relation between specific quality standards and production systems for monogastric animals.

63 www.animaltaskforce.eu

Climate change mitigation and adaptation

1.10 Agroforestry for climate change mitigation and biodiversity

Specific challenge

Agroforestry has a positive impact on sustainability (Sustainable Development Goal (SDG) 12) and biodiversity (SDG 15) and has the potential for carbon sequestration in soils thereby lowering atmospheric CO2 levels (SDG 13). Solid data are lacking on the contribution of different agroforestry systems, and within systems of different combinations of trees, crops and animals. There is a need for the development and testing of new systems or combinations in which more atmospheric CO2 may be sequestered in the soil while at the same time increasing (functional) biodiversity.

Since the scale of agroforestry is still limited, the total EU-wide effect of carbon sequestration is limited as well. Farmers lack information and examples relevant to their own region and/or climatic conditions to make them consider taking up such systems. Finally, the lack of detailed data on the effects on carbon sequestration and biodiversity of the various elements in agroforestry systems prevents the use of these ecosystems services to be remunerated in a future CAP system based on delivery of public goods.

Scope

Agroforestry is a broad concept involving different combinations of trees, animals and/or crops in different spatial systems and for different purposes. In order to assess and compare the effectiveness of different agroforestry systems for carbon sequestration and other ecosystems services (e.g. impact on biodiversity), accurate and reliable data need to be gathered. This needs to happen not only at the system level, but also in detail as regards the contribution and interaction of different species grown in the different components of the agroforestry system. Such data will enable the optimisation of current agroforestry systems for carbon sequestration in various climates and soil types.

Implementation of new agroforestry systems should be encouraged as part of participative, practice-oriented and multi-actor research in which agroforestry systems are adapted to the specific region, soil type and climatic conditions. Such locally adapted agroforestry designs should be explained to farmers and farm advisers through a network of demonstration sites distributed throughout the EU. While new demonstration sites of various agroforestry systems are set up, carbon sequestration should be monitored as input for future optimization of agroforestry systems, and basic data should be collected, enabling future modifications of the CAP towards remuneration of public goods, in this case carbon sequestration and biodiversity.

Expected impact

- Basic data on soil carbon sequestration and biodiversity effects of different agroforestry systems and key species within those systems collected in a public database;
- new showcases and demonstration sites of agroforestry systems fully adapted to regional climatic conditions;
- implementation of agroforestry on a much larger scale in the EU;
- more carbon sequestration in soils, higher biodiversity, improved nutrient cycles within fields and prevention of nitrogen leaching to ground and surface water;
- data on which future modifications of the CAP towards remuneration of public goods can be based.

1.11 Climate-resilient grass-fed ruminants

This topic was developed together with the Animal Task Force[64].

Specific challenge

Grasslands include permanent grassland as well as grass-legume leys that are part of crop rotations on arable land. The utilization of grasslands by ruminants is seen as an important means to produce animal products without compromising arable land for food production. Ruminant production on grasslands plays an important role in terms of carbon sequestration in soils, but there is potential for improvement through more precise and smart grassland management, fodder production systems (e.g. new approaches for grass-legume integration) and feeding strategies.

Grass-legume leys face the challenge that the proportion of clover in the grass-clover mix declines over time. When the legumes disappear, farmers plough the field resulting in rapid mineralisation of soil organic matter, CO2 and N2O emissions, followed by nitrate leaching to ground and surface water. At the same time, farmers sometimes experience that legumes become too dominant in grassland as well.

Secondary plant metabolites like tannins, contained in many herbs and shrubs, play important roles in ruminant metabolism. They represent a link between floral biodiversity and climate impacts (GHG emissions), resource efficiency and animal welfare (parasite mitigation). However, interactions between species, and potentially positive effects on the soil, animal health and feed conversion efficiency still need to be investigated in different climatic regions and soil types to optimize the benefits of grass-legume-herbs mixes. Appropriate dynamic models which link feeding behaviour, and metabolic responses to fodder quality are needed in order to design smart grassland-based feeding and management systems.

Scope

Forage-based feeding systems for ruminants need to be developed, which balance dietary needs through a diversity of roughage sources rather than concentrates, also taking advantage of the effects of plant secondary metabolites on feeding behaviour, digestion, feed efficiency and animal health and welfare. Natural animal behaviour (feed selection or avoidance, sequences in time etc.) should be respected and integrated into modern, dynamic and smart precision feeding systems. Systematic experiments and subsequent dynamic modelling are needed to optimize nutrient efficiency of different fodder compositions and herbal additives. In order to optimize the connection between grassland biodiversity, resource efficiency and animal health and welfare, modern technology-based pasture management and control techniques have to be developed (GPS-, sensor-, and camera-based). The same is necessary for forage conservation, storage and feeding techniques that will enable the best use of the grassland.

Causes of the decline in or dominance of legumes in mixed stands of grass-legumes should be investigated under different geographical and climatic conditions in the EU. This should serve to develop solutions to achieve the right balance in mixed grass-legume stands. Legumes varieties (e.g. clover, alfalfa and sainfoin) and germplasm need to be screened for extended persistence. The potential of a broad range of deeper rooting herbs in the grass-legume stand to promote biodiversity and improve water and nutrient cycling should be explored. Herb species and varieties should be screened for their micronutrient-uptake-efficiency, drought tolerance, allelopathic after-effects on reseeding, feed efficiency and animal health.

Expected Impact

- Grassland management based on better knowledge of grass-legume-herb-animal interactions;
- increased resource efficiency and sustainability of grasslands;
- recommendations for dynamic feeding and grazing;
- more natural livestock production, which supports animal welfare and health and ecological sustainability, while being based on modern technology and modelling;
- increased botanical diversity in grasslands;
- better insight into causes of the decline in legumes in mixed grass-legume stands;
- recommendations for improving management of grass-legume-herb stands, adapted to different regions within the EU;
- reduced need for grass-legume rejuvenation, resulting in increased carbon sequestration, reduced CO2 emission and prevention of N-leaching.

64 www.animaltaskforce.eu

1.12 Carbon sequestration and soil management for mitigation and adaptation to climate change

Specific challenge

Climate change poses great challenges to European agriculture. European farming systems need to adapt to more extreme weather events. Especially arable and horticultural systems with low proportions of perennial leys in the rotation, need measures to increase soil quality and soil organic carbon (SOC) levels, for carbon storage and resilience to extreme weather conditions like drought or flooding. Reduced tillage one suggestion for part of the solution but poses challenges for organic arable farming as regards weeds control. A specific challenge is the seed bed preparation in spring under reduced tillage practices and increased water scarcity.

Scope

Research is needed into arable and horticultural farming systems design and soil management techniques including conservation tillage for improved climate mitigation and adaptation. Special attention should go to developing techniques and appropriate equipment for controlling and suppressing weeds in conservation tillage without using herbicides.

A focus is to design and assess arable and horticultural cropping systems both concerning yield performance, diversity, carbon sequestration, fuel reduction and economic viability in different climatic zones in Europe. This will also serve the future revision of the CAP in which public goods provided by farmers are directly remunerated.

Expected impact

- Reduced climate impact by increased carbon sequestration in organic arable and horticultural systems;
- more extensive data on carbon sequestration potential for different soil management practices in organic farming systems, including conservation tillage;
- increased resilience and multifunctionality on organic farms by diversification and increased soil quality;
- more productive cropping systems with reduced tillage combined with effective weed management in organic arable and horticultural farming under different climatic conditions;
- strengthened economic resilience of organic farming operations adapted to climatic change.

2 Redesign of food and agricultural policies from local to EU level

Coordinators: Karin Ulmer & Miguel de Porras Acuña

To achieve the transformation of European agri-food sector a new farm-to-fork strategy on sustainable food along the whole value chain is needed. A profound revision of the Common Agricultural Policy (CAP) is essential. The new CAP post 2020 should support a diverse and environmentally friendly farming sector and deliver for rural development. The new CAP post 2020 provides possibilities for the development of support measures (eco-schemes) which require addressing environmental objectives. Organic farming can play a vital role in this transformation, but this requires the continuation of a strong European framework in defining organic production (as in Regulation EC/848/2018) and common guidelines for support schemes. Research accompanying the implementation of the new policy framework should address the impact of the CAP regime post 2020 on the transition toward a more sustainable food system in Europe and specifically, on the organic sector and policy measures that can be included in other EU policies, such as regional, national and European Organic Action Plans.

Food and farming systems in Europe are also driven by policies other than the CAP. New policies mixes should consider hidden costs and externalities and better assess the synergies and trade-offs between agricultural practices, public goods and ecosystem services. Stringent monitoring systems that measure the progress towards sustainability in Europe and assess the contribution of organics and agro-ecology to the food security beyond Europe are required.

Finally, food procurement policies of local, regional and national public authorities and private bodies have a key role to play in encouraging more sustainable production and in supporting rural economies. They need to be designed in a way that supports young and new entrants into farming.

2.1 Better farming policies post 2020 for a more sustainable and diverse farming sector in the EU

Specific challenges

Strong growth in demand for organic products tends to exceed EU domestic organic production in many countries but with strong differences. The gap between the supply and demand of organic products results in increased imports potentially including products which can be supplied by the[65]. There is an intrinsic imbalance between the rigidity of the organic supply and the immediacy of change of consumer preferences. Converting a farm to organic requires a substantial change in the productive structure of the farm and the marketing strategies, and thus benefits from guaranteed support measures. On the other hand, a decline in organic consumption can clearly happen almost immediately, creating the conditions for a potential weakness of the whole organic sector. Also, due to strong growth of the sector in some countries, new entrants (farmers, retailers, processors) are pushing the boundaries of an old "niche" towards a mainstream consolidated sector.

Better knowledge of the socio-economic and regulatory factors that drive the behaviour of farmers, other organic operators and consumers, both in terms of conversion and in exiting the sector, is needed in order to design effective regulations and policies. Regulations and support measures need to allow for the transition of new entrants to the organic sector and to understand their needs in order to maintain organics as an efficient production system capable of meeting the demand of EU consumers whilst upholding the founding principles.

Scope

Research should evaluate the impact of the national implementation of the CAP post-2020 on the sustainability of EU agriculture as well as the development of the organic sector in Member States. Particular attention is needed to strengthen long-term environmental indicators within the new results-based CAP framework, supported by the latest scientific findings. Building on previous studies on organic policy support schemes, projects should map new support policies in all Member States and regions. These policies should be assessed for their efficiency and effectiveness, covering availability of organic support payments (conversion to and maintaining organic farming), costs of certification, market development and the availability of knowledge relevant to organic farming through training and advisory support. In addition, test projects on pilot farms and regions, combining innovative agronomic systems with novel measurement and administrative methods should be carried out, including comparisons with previous

65 European Commission, 2019c

programming periods. Further activities should look at whether the common indicators used really do recognize public good delivery from whole farm schemes like organic, and at other policy instruments that Members States may have used when supporting the organic sector.

Research proposals should also explore socio-economic aspects of conversion and reversion of both farmers and consumers from/to conventional agriculture and food products, which should include foresight activities. On the supply side, the research should identify the optimal enabling environment and the drivers to convert to organic farming, as well as the barriers and other factors that induce reversion. Special attention should be given to family farms and the role of supply chains. On the demand side, consumer research will be used to investigate motivations, barriers to purchase and habit formation on organic consumption, including reasons and dynamics of consumer reversion.

Expected impact

- Provide support to policy makers and stakeholders with a set of incentives/legal/economic instruments by sharing the good practice at national and regional level;
- support to Member States in developing ambitious CAP strategic plans to maximise the adoption of agricultural environmental practices and monitor effectiveness of implementation;
- support in transition towards an EU food policy framework based on multifunctionality;
- better understanding of farmer's responsiveness to incentives to convert to organic as well as consumer's behaviour to be considered in policy making;
- new policies supporting the transformation of other supply chain actors (e.g. retailers, input manufacturers, breeders) in line with quality expectations and principles of organic agriculture;
- better and more sustainable farming practices are identified and promoted to maintain the principles of organic agriculture and the trust of European consumers that organic farming contributes positively to the environment;
- contribution to achieving the SDGs through the CAP.

2.2 Measuring agricultural sustainability and public goods in EU agriculture

Specific challenge

The new CAP delivery model and the shift towards a more results and performance-based approach offer a window of opportunities to address good environmental practices. While considerable research has been undertaken to assess the environmental impacts of specific farming practices in different contexts, there is still no widely accepted definition of environmental outcomes, sustainability and public goods and how to measure them so that that they can be more closely linked to policy instruments, although a framework of indicators for the monitoring of the new CAP is under discussion. Such a framework needs to reflect the real impact of measures, covering a wide range of objectives, including contribution to landscapes and to biodiversity, resource use efficiency, animal welfare and rural development and potential synergies and trade-offs between them.

The FAO estimates the hidden annual environmental costs of world food production to total USD 2.1 trillion, and the hidden social costs to be even higher (i.e. USD 2.7 trillion)66. There is some indication that environmental externalities of organic food production are consistently lower than those for conventional, but there are very few rigorous studies adopting a more widely accepted approach[67]. The contribution of organic food systems to public goods is not necessarily reflected in the prices paid by consumers as it is often challenging to evaluate such effects.

Through methodologies that look at true value and cost accounting, public subsidies and direct payments to farmers could be coupled to food systems that provide public goods and ecosystem services[68]. Food systems that reflect hidden costs and externalities are a key instrument within the market economy for steering consumption patterns towards environmental and societal needs. It is therefore highly relevant to make the high future costs of current low prices as well as the public goods generated by organic food systems visible[69].

Scope

Research should focus on the improvement and broadening of sustainability assessment and management tools. The new CAP introduces one specific tool for nutrients (FaST), but the scope of this tool is rather limited, and reliability of data collected is untested. Projects should focus on the inclusion of other dimensions of sustainability in such tools, such as biodiversity (plants, animals, soil organisms, pollina-

66 FAO, 2014
67 TEEB, 2018
68 IFOAM – Organics International & SOAAN, 2016
69 Sustainable Food Trust, 2019

tors), greenhouse gas emissions, energy consumption, environment (incl. pesticides), animal welfare (incl. antibiotics), among others. This should build on existing frameworks such as FAO's SAFA Guidelines[70] and recent scientific evidence on how to measure impacts. These tools should be improved and refined to allow for fair and reasonable comparisons, to be applicable not only to farmers but to other actors in the agri-food value chain (retailers, processors, etc), as well as to consider the expectations of consumers for more transparency in the sustainability of their food.

Proposals should further develop and adapt reliable and rigorous methodologies to evaluate the internalisation of externalities in the cost of agricultural production. True Cost Accounting (TCA) is a promising approach, but significant developments are needed to improve it and the availability of data for such an approach. Other promising methods that still need further development and research include calculations of Quality-Adjusted Life Year (QALYs) and Disability-Adjusted Life Year (DALYs), which are especially useful in guiding the allocation of public and private resources. The calculations provide a common numerator, allowing for the expression of utility in terms of eur/QALY or eur/DALY. Projects should use such methodologies to compare the performance of organic vs. conventional food systems, either in monetary or non-monetary terms. Through the collection of data from many localities with carefully chosen comparative systems and supply chains (including organic farming) from different geo-climatic areas in Europe, the application of these different methodologies will strengthen the evidence base to assess how organic practices deliver public good on a full economic basis.

Expected impact

- Better integration of public good delivery into policy making, especially into the CAP framework, through effective impact indicators;
- advances towards a commonly agreed framework for measuring and comparing sustainability and delivery of public goods;
- better understanding of the links between different food systems, health costs and environmental damage; between processing, packaging and public goods, and the contribution of organic food;
- robust valuation methods comparing different farming practices and systems to inform policy making;
- contribution to the improvement of sustainability and public goods delivery of organic (and conventional) food systems in practice, e.g. through best practice guidelines;
- improved communication of environmental performance and accounting of externalities of different farming systems to facilitate policy change.

70 www.fao.org/ nr/sustainability/sustainability-assessments-safa/en

2.3 Opportunities for young entrants in local sustainable food systems through green public procurement

Specific challenge

Strengthening the socio-economic fabric of rural economies is mentioned as one of the nine CAP objectives[71], but the lack of generational renewal in the EU is a problem. In 2013, the average age of European farmers was 51.4 years[72]. Organic farming attracts younger farmers, with evidence showing that 61% of farmers are younger than 55 in the organic sector, whereas they represent only 45% in the conventional sector[73]. One reasons for this lack of interest of young people entering the farming sector might be the fact that supply chains have not delivered on providing fair farm gate prices and fair distribution of added value between farmers and other actors in the value chain. Local economies, short food chains and the use of European quality labels can be alternative models, serving as a motivation to young entrants but there is lack of evidence in support of such claims. Food procurement policies of local, regional and national public authorities and private bodies have a key role to play in encouraging more sustainable production and in supporting rural economies. Organic food is recognised under European Commission guidelines for green public procurement[74]. It is easy to specify as it is covered by EU regulations. However, many authorities do not specify organic food in their procurement policies, in some cases due to concerns about higher costs.

Scope

Research should identify examples of green public procurement policies, models and measures (including public, private and public-public partnerships). Comparative case studies in selected countries and regions (both urban and rural) projects should evaluate initiatives such as local food hubs, organic districts, eco-regions, community kitchens, food education, and short supply chains and identify factors that are contributing to success, including citizen engagement, value added for primary producers and along the supply chain, economies of scale, as well as policy framework and institutional and other barriers, including reasons for not specifying organic as a quality standard in green procurement policies.

With reference to agreed CAP monitoring indicators, projects should further evaluate what impact green public procurement policies have on the local regions and their potential for creating opportunities for new entrants in farming and enhancing local food networks. Research should develop new business models for local sustainable

71 Commission proposal on CAP Strategic Plans, Commission proposal on CAP Strategic Plans, Article 5c; see also Article 6 a, c, g, h, and i
72 For more details, see European Union, 2017
73 European Commission, 2016, p. 23, graph 17
74 European Union, 2016

food supply, for young entrants and women farmers, considering issues of land access, advisory and mentoring support, as well as the distribution of risks and rewards and the potential of capital grant schemes. Ambitious policy recommendations for supporting new entrants and for green public procurement should be developed at all levels, from local authorities to European policies. To connect well with various stakeholders, projects should use action-based research, and support municipalities that want to venture into some of those areas.

Expected impact

- Creation of a network of cities and regions developing local food systems;
- new opportunities for young farmers in the sustainable local food networks, ensuring generational renewal as well as preventing the de-population of rural areas;
- development of innovative business models which emphasise diversity and resilience, for example integrated cropping and livestock, improved relationships between producers and consumers;
- improved capacity of policy makers and stakeholders to make informed decisions about public procurement based on a thorough knowledge of the different business models;
- ambitious regional strategies and roadmaps for the development of local food systems, green public procurement at every level of administration and opportunities for new entrants.

2.4 Contribution of organics and agroecology to food security and sustainable management of natural resources on a global level

Specific challenge

Studies have shown that organic and agroecological approaches can be effective at addressing food security and sustainable resource management in various global contexts[75]. Various initiatives at global level show successful examples of scaling-up of organic and agroecological agriculture. There is a need to assess the transformative potential of agroecological and organic farming using a broad and comprehensive framework that allows for the evaluation of impacts, considering trade-offs and synergies and potential positive/negative externalities in the process of upscaling organic farming and agroecology at a global scale.

Scope

The project should assess the contribution of organic agriculture to the UN Sustainable Development Goals and to the Paris Agreement. This involves learning lessons from existing initiatives and building on established frameworks for impact evaluation of the sustainability of food systems such as the FAO's SAFA guidelines. Assessments should consider food security, food safety, nutrition, agricultural technologies as well as synergies and potentially negative implications, such as loss of indigenous varieties or landrace. They should also cover gender issues, positive and negative impacts on socio-cultural integration and cultural identity, empowerment of small farmers and political dynamics considering the principles and practice of both organic agriculture regulations and agroecology. International consortia should be multi-disciplinary and link to the EU-Africa Partnership on Food and Nutrition Security and Sustainable Agriculture.

Expected impact

- Sound framework for assessing the impact of organic farming and agroecological farming systems on the SDGs;
- empowerment of organic farmers and other actors in low-income countries to improve their resilience and innovation capacities;
- better understanding of the role of socio-political factors in measuring the impact of organic and agroecological systems at a global level.

75 IPES-Food, 2016

2.5 Strengthening knowledge and innovation systems for organics through digital tools

Specific challenge

Agricultural Knowledge and Information Systems (AKIS) are key for the implementation of organic and agroecological practices. However, the knowledge and innovation systems for organic farming are neither well embedded in national innovation systems, nor are they well connected between the Member States. The organic sector has a strong tradition of self-help groups, and of producers, advisors and researchers working together to develop solutions. Yet little is known about how to foster effective and efficient innovation systems for the specific circumstances of the organic food and farming sector. The sector needs targeted advisory services that cover a large range of technical solutions, networking, training and demonstration approaches.

At the same time, organic advisory services are going to change fundamentally in the coming years. The complexity of information collected in (organic) farming leads to huge amounts of data that need to be processed with the help algorithms. Artificial intelligence might therefore become part of knowledge exchange in organic agriculture. Organic advisory systems that use digital methods are therefore essential for effective knowledge exchange.

Scope

Research should foster the establishment of a permanent network of organic advisory services and demonstration farms embedded in national and European innovation systems. It should map existing provisions and initiatives in advisory services for organic farming and agroecology (from public and private providers including control bodies). The needs and preferences of potential actors (e.g., farmers, advisors, innovation brokers and consumers) for enhancing innovation towards greater sustainability and supporting strategic and transformative change on farms should be assessed. The network should in particular tackle the East-West divide in knowledge on organic farming and propose methods for increased knowledge exchange across Europe.

Building on and complementing the outcomes and activities at EU level (e.g. FarmDemo, NEFERTITI, CORE organic) research should explore the role and importance of on-farm research and farmer-led trials, multi-actor innovation and how they can be complemented with online knowledge exchange, digitally supported farmer field schools and knowledge reservoirs (e.g. link with Organic Farm Knowledge[76], EURAKNOS[77]). Research should focus on the role of group facilitation in sharing knowledge between farmers with different levels of experience and on the integration of local knowledge into digital tools while protecting farmers' rights and preventing data misuse. Projects should also examine how the algorithms of e-learning and e-advice systems could be adapted to the needs of organic farmers. Developers, users, researchers, practitioners, advisors, entrepreneurs and legislators need to discuss the compatibility of certain digital technologies with agroecological and organic principles and develop joint approaches.

Expected impact

- A European network of organic advisory services, demonstration farms and on-farm research;
- increased use of digital knowledge exchange tools and ICT applications in the organic and agroecological sector;
- better integration of organic research results in AKIS systems for the support of knowledge reservoirs;
- better integration of local knowledge in digital tools and involvement of farmers in the co-creation of scientific knowledge through digital means.

76 www.organic-farmknowledge.org
77 www.euraknos.eu

3 Sustainable value chains for better food systems

Coordinator: Raffaele Zanoli

To feed the world sustainably, not only must agricultural efficiency and productivity increase (especially in organic agriculture), but also resource efficiency and sufficiency in consumption has to become a common social practice.

It is increasingly acknowledged that food processing, distribution and consumption, including sustainable diets, must be better integrated in an organic food systems approach. Within the organic food system, one of the major questions is how to operate on each step of the food chain in accordance with organic values and principles, including processing and packaging35. While organic agriculture is now established as a more sustainable method of production, further research and innovation is required to increase the sustainability and efficiency of the whole organic agri-food chain, contributing to consumer trust and enhancing consumer acceptance of organic food products. While implicated, the link of organic food systems to sustainable/healthy diets and other public goods that benefit society at large needs further investigation to form the basis for promoting, implementing, and further developing sustainable organic value chains.

The topics included in this chapter aim at strengthening the European food sector through more efficient and sustainable processing, innovation in packaging and waste reduction, food safety, traceability and delivery of sustainable and healthy diets.

3.1 Consumer demand for minimal processing

Specific challenge

In Europe, organic raw materials are processed to food products by more than 60,000 processors[78]. The value of the retail market and per capita consumer spending on organic food has doubled in the last decade[79]. Consumers care more about sustainability, animal welfare and health and want to know more about their food. They continuously demand pure products, wish to avoid additives and GMOs, and prefer gently processed foods. At the same time consumers' knowledge of contemporary food production is low and nutrition skills are in decline. Together, these factors serve to create a strong demand for organic foods with fewer additives and minimal processing.

Processors are provided with a framework for organic food production by the EU regulations. The use of food additives is regulated by a positive list while processing is not further differentiated. Formulations reducing or phasing out additives typically correspond with increased processing hence these issues need to be addressed in parallel. Natural food additives provide an alternative to synthetic additives and both processors and consumers will contribute to a growth in their demand. Natural food additives, specific for organic foods across application categories, are therefore needed that are in line with the principles and objectives of organic food and farming.

Scope

Research should investigate the potential for and application of natural additives across application categories (including foodservice) as well as across processing technologies and scales. Food enzyme and nutrient alternatives for organic food production can similarly be addressed. Research should identify current available evidence of health impacts and safety. Furthermore, research should investigate behaviour and properties during processing and in end products, as well as determining changes in quality attributes. A comprehensive study will address sourcing issues such as quality, guarantees and volumes as well as evaluate ingredients across all sustainability dimensions.

On the consumer side, research needs to study attitudes, beliefs and intentions regarding buying and eating behaviour concerning foods with and without additives. Motivational research should aim to understand why consumers behave as they do regarding additives and behavioural research should aim to understand their behaviour such as around consumption choices. Consumer acceptance of natural additives and organic products using these is to be determined. Consumer knowledge studies will be used to

78 Willer & Lernoud, 2019
79 Ibid.

assess knowledge levels, information and misinformation, as well as food literacy with respect to synthetic and natural additives, their functions and links with processing. Ethnographic and social practice approaches are also encouraged.

The impact of education, both formal and informal, and various forms of communication about additives, (organic) food production and processing should be the focus of further research. Facilitation of desired behaviours will be the focus of research applying theories of social psychology to behaviour.

Expected impact

- A strengthened organic food sector with spill overs to non-organic food and beverage sectors;
- increased sustainability of diets;
- improved consumer acceptance and trust in organic food.

3.2 Innovation for reducing food and packaging waste

Specific challenge

While there has been much research into innovative food packaging technologies and solutions aimed at reducing the environmental footprint of packaging materials, little has been done to tackle the issue of food and related packaging waste by innovations along the food supply chain. The impact of the food chain is wider than what happens on farm, with the cool chain, for example, being responsible for a large proportion of the EU's energy consumption.

Using digital technologies, the use of energy can be managed efficiently allowing greater use of renewable energy to produce food. Similarly, water efficiency can be improved by using sensors and control systems to target water use more precisely. In the organic sector, specifically, there is a need for innovations that reduce waste by minimal and reusable packaging, facilitate public procurement, and for social innovations such as last-minute/food recovery marketing platforms targeted to the organic sector. A proper regulatory environment favouring the reuse of food packaging is also needed. A new holistic, systemic approach to the design of production, processing and handling processes is required to help reduce waste at every stage of the organic agri-food supply chain.

Scope

Research should address challenges of reducing food and packaging waste in organic supply chains. The research will provide in-depth understanding of organic stakeholders' perception and behaviour with respect to these challenges potentially resulting in the design of new processes leading to new business models and better performing value chains. Proposals may also identify incentives and barriers to the uptake of existing strategies, solutions and tools (e.g. reusable shoppers and food containers, minimal packaging designs, last-minute marketing platforms and applications, other digital technologies), as well as validate the benefits of these strategies for users/buyers and measure the technical and economic performance at a system level. Research should include activities to ensure consumer and societal acceptance, optimise access to and the dissemination of results and explore policies and regulatory requirements aimed at reducing food and packaging waste along organic food chains.

Expected impact

- Reduced food and packaging waste in organic agri-food chains, and hence reduced negative impacts on the environment;
- increased sustainability in the EU organic food market, contributing to consumer trust and more efficient resource use and reuse;
- better uptake of both technological and social innovations, contributing to a greater circularity in the economy.

3.3 Sustainable and healthy organic diets

Specific challenge

Nearly 10% of the EU population are not able to afford a regular quality meal every second day[80]. Europe is the continent most severely affected by non-communicable diseases. These are the leading causes of disability and death linked to the way we eat and drink. While organic agriculture improves the sustainability performance on the production side, there is also a need to address the way consumers approach their diets to lower the impact of food consumption on the environment while supporting the demand (and supply) of organic food that is nutritionally adequate, safe and healthy. The consumption patterns of regular organic consumers seem to be close to the sustainable diet concept of the FAO and fixing the diet in an organic way may help achieve the SDGs[81]. However, growth in demand for organic food has brought many processed and ultra-processed food products on the market that do not correspond fully to the organic principles and to sustainable and healthy diets. There is a need to educate and inform processors, retailers and consumers of the risks associated with the "conventionalisation" of organic diets.

Scope

Proposals should explore consumer food habits and current diets to identify patterns that distinguish organic consumers' approaches to food and diets. Understanding consumer preferences and attitudes to organic food in relation to the overall sustainability and healthiness of their diets is core to achieving a greener and healthier organic demand. Customer centricity will be the basis for a Design Thinking approach to develop the right tools to promote more sustainable and healthier organic diets (e.g., labelling schemes and devices, apps and other software, official guidelines, etc.). Proposals should analyse the role of organic foods in different European food cultures and diets, as well the relationship between the consumption of organic food on the food literacy of consumers.

Research should address ways to optimise organic food systems and supply chains to favour the adoption of greener and healthier food consumption behaviours and to enable more responsible, sustainable and healthier organic diets that could benefit the whole society and go a long way towards achieving the SDGs.

Expected impact

- Identification of sustainable organic diets that are protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair, and affordable;
- optimisation of organic food systems to facilitate more sustainable and healthier organic diets;
- promotion of sustainable and healthy organic diets.

80 IPES-Food, 2019
81 Strassner et al., 2015

3.4 Food safety in the organic value chain

Specific challenge

Food safety continues to be a priority for EU and global food policies. Although the food supply in the EU has never been so safe as today, the World Health Organisation estimates that food-borne bacteria, parasites, toxins and allergens still cause about 23 million cases of illnesses and 5,000 deaths in Europe every year[82]. Furthermore, the European citizen does not have full confidence in food supply systems. There is also a need to anticipate unknown/emerging risks that may arise because of environmental, economic and societal changes. European organic food chains, although more sustainable and led by principles that reduce the risks for consumers and citizens of being exposed to hazardous pesticides and other chemicals, are facing stricter protocols to avoid external accidental contamination while controlling microbiological safety and preventing food-borne diseases. Given that organic regulations ban most synthetic additives and preservatives in organic food production and processing, there is a need to ensure food safety by alternative, often more costly processing methods, and to develop risk assessment methods specially tailored to organic food systems.

Scope

Proposals should explore solutions to support improved risk assessment and risk management to ensure organic food stays safe at every stage of the value chain and even beyond. Research should examine the use of digital technologies (sensors, blockchain, IoT etc) and develop techniques and protocols to minimize accidental contamination with pesticides and other non-admissible substances, contamination with food-borne bacteria, problems with imported organic raw materials and food as well as to fully account for the specific risks of each organic food supply chain. Research should review current agronomic methods and post-harvest strategies to reduce contamination of food and produce, as well as provide an updated state-of-the art quality assurance strategies relating to specific organic food sectors.

Expected impact

- Improved safety, quality and health benefits of organic food;
- development and promotion of best-practice risk assessment methods and safety protocols;
- further reduction in health risks for consumers of organic food.

82 WHO, 2015

3.5 Digital solutions for transparency across the value chains

Specific challenge

Across Europe, consumers' interest in the impact of food on the environment and health has been increasing. Consumers expect more transparency in the food chain regarding sustainability of production and origin of food. The faster pace of life and changing family structures require new and more efficient ways of buying and recovering food (e.g. via food sharing platforms). Yet, most food in Europe is still supplied using traditional supply chain models in which consumers travel to buy food from central points (markets or shops) with limited information about the provenance and quality of the food available. Therefore, new business models that fulfil both consumers' expectations and the need for more flexibility and traceability need to be developed. On the production side, there is a need to optimize the logistics, storage and distribution of food to reduce environmental impacts and shorten the value chains.

Scope

Research should focus on developing and providing end-to-end traceability, through digital technologies (such as blockchain, artificial intelligence and IoT) to ensure traceability on every input and transaction occurring to a food product from field to consumer.

Blockchain is one of the digital technologies that has the potential to increase transparency and consumer trust in the value chains by potentially ensuring a better traceability, less fraud, and more consumers' trust. A proper assessment of its potential negative and positive impacts is needed given the lack of studies that examine the impacts and effects of this technology.

Digital solutions could help reduce the need for centralised distribution infrastructure by allowing smaller consignments to be automatically routed to their ultimate destination in one journey. If the governance of the data is organised in a balanced way and market imperfections are tackled sufficiently, this can help to facilitate collaborative approaches to reducing waste and increasing production efficiency.

To shorten the value chains, new business models that empower local and small business need to be developed. Local businesses have to adapt their practice and implement e-commerce as it is a critical revenue source and route to reach consumers. Psychological and neurological research is needed to determine how consumers make their decisions and whether and how sustainable consumption patterns can be achieved at scale.

Expected impact

- Shorter food chains with a consequential reduction in inefficiency and waste and possibilities for direct interaction between consumers and producers;
- enhanced ability of organic businesses to sell their products in a more sustainable way and to induce a change in consumption and reduce waste;
- development of viable business models for smaller sized companies making them more sustainable in the digital age;
- increased consumer trust in food by more efficient and transparent food chains.

RECOMMENDATIONS FOR POLICY-MAKERS

Our food and farming systems in Europe are facing multiple interrelated challenges. Citizens are increasingly concerned about the impacts of the food production and consumption system on the ecosystems, health and livelihoods. They want to know where the food comes, how it is made and how sustainable it is. For decades, the organic movement has been committed to providing food with a minimal environmental footprint, of the highest quality which is produced fairly. The booming organic food market in Europe reflects citizens' trust in organics and its principles.

To build on this, organics and agroecology need to develop further, inspiring and leading the transformation of the wider food systems. Research and innovation are crucial to this. They lay the foundations of our future food systems. Thanks to the efforts of TP Organics and like-minded organizations, the research investment in organic food and farming has grown from EUR 42.5 million euro in the FP7 to EUR 430 million euro in Horizon 2020[83]. However, while impressive in absolute terms, the amount of funding devoted to organics represents only 0.48% of the total FP expenditure[84]. To enable the organic sector to support the transformation of food and farming, the research and innovation investment needs to step up significantly in Horizon Europe.

TP Organics welcomes the planned Mission for Soil Health and Food in Horizon Europe that explicitly includes ecology and agroecology, the delivery of public goods and systems science/systems approaches. Better protection of our soils, the basis of food production, is urgently needed. Research must consider how findings can be implemented in practice.

In the cluster "Food, Bioeconomy, Natural Resources, Agriculture and Environment", priority should be given to organic and agroecological approaches that use natural resources efficiently and sustainably, create circular systems, and reduce soil erosion and pollution of the environment.

Furthermore, the partnerships "Safe and Sustainable Food System for People, Planet & Climate" and "Accelerating farming systems transition" will prove essential in the transition to sustainable food systems and upscaling of organic farming and agroecology. The partnerships must build on experiences of previous instruments, in particular ERA-NET CORE Organic that has already funded research into agroecological processes and organic farming for 15 years. They should also be open to all actors in the agri-food chain and engage with citizens and civil society organisations.

TP Organics welcomes the planned Mission for Soil Health and Food in Horizon Europe that explicitly includes ecology and agroecology and the delivery of public goods. The multi-actor cooperation championed by the EIP-AGRI in Horizon 2020 should be strengthened in Horizon Europe by better engaging advisers and organic actors who have a track record in participatory and collaborative approaches to innovation. The definition of innovation in Horizon Europe should go beyond a technology bias, remaining broad, context-specific and serving the public good.

To conclude, the Strategic Research and Innovation Agenda for Organics and Agroecology identified 4 priority research areas (moving organics further, redesign of food and agricultural policies, climate-resilient and diversified farming systems, and sustainable value chains) and 29 potential topics to be addressed. TP Organics is convinced that by dedicating appropriate funding and support to these priority areas will help steer Europe's food and farming systems towards full sustainability and thriving societies.

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83 Excluding the amount dedicated in the 2020 Work Programme of Horizon 2020
84 Cuoco, 2018

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