

Research and Development Strategy 2019-2021

for

Organic Agriculture and Food Systems





**Research and Development Strategy 2019-2021
for
Organic Agriculture and Food Systems
'Sustainability, innovation, growth and credibility'**

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Photo p. 6: Organic RDD-project SuperGrassPork
Photo p. 7: Organic RDD-project SuperGrassPork
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Publisher

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Preface

Denmark is at the forefront internationally in terms of prioritizing research that aims to strengthen sustainable organic agriculture and sustainable food systems. The research has contributed to making organic products marketable, secured increase in agricultural productivity and strengthened the sustainability. Without this basis, the market for organic products in Denmark would not be as diversified, competitive and attractive as it is today.

We must continue to invest in research, development and innovation to further strengthen the contribution of organic agriculture to society within areas such as environment and climate, biodiversity, drinking water protection, animal welfare and health. In addition, organic agriculture is an obvious tool for the achievement of the broader societal goals, and the basic principles of organic agriculture are closely linked to the UN Sustainable Development Goals.

The International Center for Research in Organic Food Systems (ICROFS) coordinates, disseminates and promotes research within organic agriculture and food systems both nationally and internationally. With a high scientific level and the active involvement of farmers, consumers, advisers, authorities and companies in the prioritization of research topics and projects, the organic research programs have been a cornerstone in the development of new products and methods in organic production and organic food systems.

The research and development strategy has been prepared by ICROFS with broad involvement of primary producers, industry and trade, organizations, consumers, research institutions and authorities.

The vision of the strategy is to support a Danish, market driven and sustainable organic world-class food production, based on research and innovation.

Jakob Sehested
Director
ICROFS

Louise Gade
Chairman of the board
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ICROFS

International Centre for Research in Organic Food Systems (ICROFS) was established by the Ministry of Environment and Food of Denmark in 1996. ICROFS' mission is to coordinate, execute and disseminate strategic and application-oriented research of high and international standard, which contributes to the development of a sustainable, market-driven and competitive Danish organic sector. The board of ICROFS has broad representation from primary producers, industry, research institutes, consumers, organizations and authorities.

Background

Organic agriculture and food production are experiencing a positive and consumer-driven growth based on sustainability, consumer confidence, innovation and strong values.

The EU Council Regulation on organic production defines organic production as an overall system of farm management and food production that combines best environmental and climate action practices, a high level of biodiversity, the preservation of natural resources and the application of high animal welfare standards and high production standards in line with the demand of a growing number of consumers for products produced using natural substances and processes.

Organic production thus plays a dual role in society - on the one hand supplying a specific market that meets consumers' demand for organic products - and on the other, providing public goods that contribute to the protection of climate and the environment, biodiversity, animal welfare and rural development. In addition, the four basic principles of organics - health, fairness, ecology, and care - are closely linked to the UN's Sustainable Development Goals, which recognise that social, economic and environmental development are closely linked and require integrated efforts.

Therefore, ICROFS' research strategy aims to support the development of organic agriculture and food systems in order to supply the market as well as meet the needs of society.

Focus areas and success criteria

Through six focus areas, ICROFS' research and development strategy addresses the central challenges and potentials of organic farming and food systems. The aim is to support a market-driven and competitive organic sector and to meet the consumers' and the society's expectations in regards to healthy and high-quality food products, and not least to contribute to sustainability and public goods.

The six focus areas of the strategy:

- CIRCULAR BIO-ECONOMY
- CLIMATE AND ENVIRONMENT
- BIODIVERSITY
- HEALTH AND WELFARE
- THE ORGANIC CONSUMER OF THE FUTURE
- ORGANIC FARMING – FOR A LIVING

The strategy aims for practice-oriented solutions and research, which is carried out in close collaboration with farmers, companies, authorities, and consumers in order to develop innovative and competitive solutions and document these in relation to consumers and society. This is reflected in the following four key success criteria to be promoted in the research projects:

- **SUSTAINABILITY** – the projects must contribute to sustainable production systems that protect the climate and the environment, be based on recycling and sustainable use of resources, and support a high degree of biodiversity, animal welfare, and health for soil, plants, animals and humans
- **INNOVATION** – the projects must contribute to innovative production systems that meet consumer and societal demands for organic products
- **GROWTH** – the projects must contribute to productive and efficient production systems that support continued sustainable growth in the organic production
- **CREDIBILITY** – the projects must contribute to the credibility of organic farming and food systems in relation to the organic principles and the contribution to public goods such as protection of climate, environment and drinking water, as well as a high degree of biodiversity and animal welfare.

The four organic principles as defined by IFOAM – Organics International

- *The principle of health:* Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible
- *The principle of fairness:* Organic Agriculture should build on relationships that ensure fairness with regards to the common environment and life opportunities.
- *The principle of ecology:* Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.
- *The principle of care:* Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.



Circular bio-economy

Recycling and sustainable utilization of resources are key principles in organic agriculture. The planet's resources must be utilized in a sustainable way, which accommodate future generations, healthy ecosystems, healthy animal feed and healthy food for humans. Organic agricultural production and food systems should therefore be based on sustainable and efficient ecological cycles and on renewable resources.

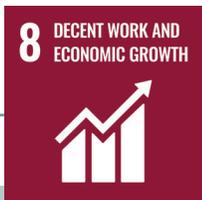
The term circular bio-economy is a composition of the terms circular economy and bio-economy, and it combines efficiency and recirculation with bio-based production. Therefore, bio-economy is a core element in organic agriculture and the key to intelligent green growth. Thus, it is crucial that new and safe solutions are developed for organic bio-based production and for the recycling of nutrients from the industry and society to organic farms.

Research and development needs

- Recycling of side-streams, residual and waste products from other parts of society (e.g. wastewater, bio-waste sorted at source and residual products from the industry) as fertilizers for crop production, and nutrients for livestock production, with regard to quantity, availability and safety, for instance content of hormone-disrupting substances and microorganisms.

- Good nutrient supply and efficient nutrient utilization; e.g. by effective utilization of nitrogen fixing crops and animal manure; development of plant-based fertilizers and soil improving material; utilization of degassed material from biogas production; utilization of side-streams from bio-refinery; composting and composting processes; innovative fertilizer strategies, and precise nutrient management.
- Bio-refinery and fermentation, possibly in combination with bio-gasification, as basis for efficient utilization of relevant bio-material such as grasses and other crops, seaweed and other water-based resources, as well as insects for production of e.g. proteins and nutrients for livestock and humans, ingredients for the food industry, substitutes for fossil-based materials and recycling of nutrients for the soil.
- Business models for circular bio-economy; e.g. business models which can be established between society's handling of nutrients (wastewater, bio-waste sorted at source and residual products from the industry) and organic agriculture; cooperation and business models for optimal nutrient distribution and utilization between organic farms; solutions for local processing and security of supply.
- Technological solutions concerning the above specific research areas, and establishment of a scientific basis for technology assessment, which can be used for development of the organic regulations in compliance with the principles of organic agriculture; e.g. innovative use of data, and information and communication technologies (ICT), which can support management of production processes, and documentation, traceability, and product safety.





Climate and environment

A fundamental principle of organic agriculture is to collaborate with the natural ecosystems and preserve a healthy climate and environment for future generations.

It is vital for the credibility of the organic sector that organic agriculture and food systems continue to improve on all parameters concerning climate and environment, and further reduce emissions of greenhouse gases, reduce loss and leaching of e.g. nitrogen and phosphate, and simultaneously increase carbon sequestration and protect drinking water reservoirs. Furthermore, organic production systems must be robust towards the effects of climate change, as robust systems are effective with lower emissions of greenhouse gasses.

Research and development needs

- Cultivation systems and technologies for organic crop production, which are resilient, increase efficiency and reduce impact on climate and environment; e.g. types of crops, combination of crops, rotation of crops and catch crops, including cultivation systems and technologies, which increase carbon sequestration, minimize emissions of greenhouse gases, reduce leaching of nutrients and retain nitrogen in the root zone during winter; types of crops and combinations, which efficiently utilize nutrients; quantification and documentation of the impact on climate and environment.
- Optimal nutrient supply, including vitamins and minerals for organic livestock and aquaculture with regard to high productivity, minimal leaching of nutrients and emissions of greenhouse gases; e.g. optimization of the nutrient supply for free-range animals and especially of the amino acids supply for monogastric animals; mineral supply from renewable resources; innovative technologies for supply of single nutrients for organic livestock; and solutions for local processing and supply.
- Production and management systems for organic production of livestock and aquaculture, which are resilient, efficient and reduce the impact on climate and environment; e.g. animal housing systems, grazing systems and types of livestock, which secure an efficient production, utilization of nutrients, carbon sequestration and low emissions, without compromising the health and welfare of the animals; technologies and systems for the management of manure, which reduce emissions of greenhouse gases, ammonia, nutrients, and thus secure efficient recycling of nutrients; combinations of crop and livestock production, e.g. agroforestry systems and the utilization of perennial crops; and quantification and documentation of the impact on climate and environment.
- Energy-efficient technology, and technology for production and utilization of renewable and bio-based energy, achieved by e.g. reduced tillage, optimization and electrification of stable and field systems; biogas production using catch crops, residual products, bi-products, manure and plant residues, in combination with efficient recycling of nutrients for crop production.
- Systems and technologies for transportation, processing, and packaging of organic food, which reduce the impact on climate and environment per unit, achieved by using e.g. sustainable materials and concepts, which reduce food waste; quantification and documentation of impacts on climate and environment.
- Technological solutions concerning the above specific research areas, and establishment of a scientific basis for technology assessment, which can be used for development of the organic regulations in accordance with the principles of organic agriculture, e.g. by innovative use of data and ICT to support management of production processes.

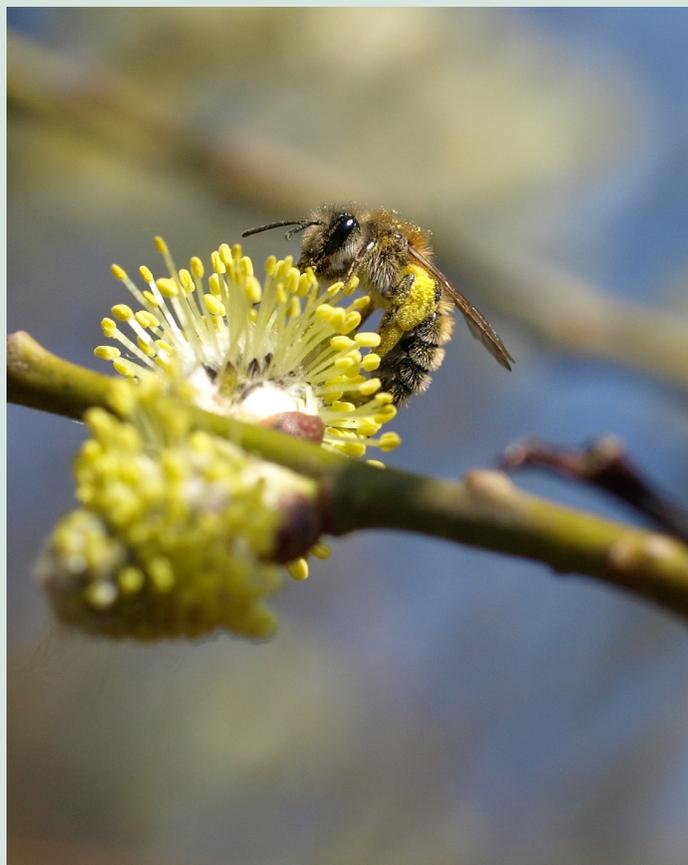




Biodiversity

It is essential for organic farming to protect nature and biodiversity. A high biodiversity in the farmed areas is also important for the organic food production, for example in terms of pollinators and other beneficial insects, microorganisms that contribute to maintaining a fertile soil, as well as birds that help control pest insects.

Protection of the biodiversity in nature areas and other uncultivated land is also an important public good, which can secure the opportunities and health of future generations. There is a need for considering biodiversity in the evaluation and development of all new production systems and technologies, and a need for knowledge on how an increase in the diversity of production and in genetic diversity can be developed and exploited in organic farming. The attention to biodiversity in the uncultivated areas must comply with the expectations of society and consumers to a rich landscape providing habitats for insects, birds, other animals and plants, as well as the need for recreational purposes.



Research and development need

- Plant cultivation and livestock production systems, initiatives and methods that support biodiversity in the cultivated soil and land areas as well as in the surrounding areas, create potential for a more focused utilization of functional biodiversity on e.g., yield and quality, meet society's need for a variety of sustainable food products and are financially sustainable for the farmer. This includes also the development of grazing systems and grass-dominated production systems, the production of biomass for bio-refinery, fermentation and bio-gas production, etc.
- Extensive production systems that integrate multiple purposes such as more and better habitats for wild animals and plants as well as the involvement of consumers in nature management. This includes, for example, the development of a concept for 'the farmer as caretaker of nature' with focus on supporting biodiversity in the farmed areas and the surrounding landscape and at the same time ensuring a profit for the farmer.
- Methods and tools for the documentation and quantification of the effects of organic farming on nature, biodiversity and ecological functions, such as documentation of improved pollination and control of pests, improved soil fertility, health and structure; knowledge on how specific cropping and production systems impact organisms in the farmed areas over time and with varying spatial scales; knowledge about limiting conditions.
- Methods and tools for value assessments of the effect of organic farming on biodiversity as a public good, which can form the basis of payment for the establishment of cropping systems and initiatives that sustain biodiversity in the farmed areas and the surrounding nature.





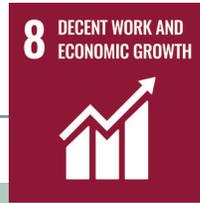
Health and welfare

In organic farming, health is viewed holistically in an inter-connection between soil, crops, animals and humans. The soil is a key resource in the production, and maintenance and development of soil fertility and health is thus a key area that also contributes positively to carbon storage. There is a need to develop organic cultivation and production systems as well as technologies, which support resilient and healthy crops, livestock and fish, and which prevent unwanted components and microorganisms from being distributed throughout the system and into the products. At the same time, further focus on the health and nutritional value of the food products is needed. Animal welfare and meeting the specific behavioral needs for each species are central aspects of the organic sector, and access to outdoor areas and grazing are thus important principles.

Research and development needs

- Organic soil tillage- and cultivation systems including technologies that maintain and develop the fertility, health and resilience of the soil, e.g. interactions between beneficial and damaging microorganisms and between microorganisms and plants; resilience to pests; decomposition of unwanted elements in connection with recirculation of nutrients from society; development of natural soil improvers, e.g. based on seaweed, algae, products from bio-gas and bio-refining processes and fermented materials.
 - Organic crop production systems, strategies and technologies that support healthy and resilient crops and reduce the use of unwanted components and prevents unwanted components and microorganisms from being distributed throughout the system and into the products, e.g. prevention and reduction of diseases; natural pesticides and innovative technologies, which enhance the resilience of the system towards diseases, pests and weed; biological control of pests and diseases; the use of probiotics.
 - Organic production systems for livestock and fish that support healthy and robust animals that reduce the use of unwanted components such as antibiotics and prevents unwanted components and microorganisms from being distributed throughout the system and into the products, e.g. reduced frequency of diseases and mortality; vaccination programmes for prevention of diseases; biological control of pests and diseases; prevention of intestinal worms, as well as the use of plant components with probiotic and/or bio-active properties.
- Housing systems and outdoor areas that support animal welfare and the natural behavior of the animals without compromising the climatic and environmental impact of the production or the health of the animals, e.g. the interaction between dams and offspring; access to outdoor areas, grazing and natural foraging behavior; low strain on the musculoskeletal system.
 - Breeding strategies- and methods, and inclusion of new and old species and varieties targeted for organic production and considering specific needs for e.g. genetic diversity, resistance to diseases or tolerance and adaption to local soil and climate conditions, e.g. crops and animals with high resilience, vitality and health; livestock adapted for organic production systems.
 - Scientific methods and concepts to assess the health-related quality of organic food compared to other types of food, e.g. by assessing the effect of the principle of care on health such as the significance of low exposure to pesticides and additives (the cocktail effect); the significance of the health aspect for consumers choosing organic food; the role and potential of organic food in regard to improving public health.
 - Technological solutions concerning the above specific research areas, and establishment of a scientific basis for technology assessment, which can be used for the development of the organic regulations in compliance with the principles of organic agriculture; e.g. innovative use of data and ICT to support management of production processes, documentation of e.g. animal welfare in organic production systems, traceability and product safety.





The organic consumer of the future

Organic farming must meet the consumer's expectations for healthy quality food and public goods such as animal welfare, biodiversity, climate, the environment and clean drinking water. At the same time, the origin of the food and sustainable supply chains are of increasing importance to the consumers. Finally, the consumers are focusing increasingly on the dietary composition in relation to nutrition and health.

Knowledge about and dialog with the consumers regarding their demands and expectations for the organic production and the organic products is crucial for the organic food system to be able to meet the expectations for the quality of the products – and to obtain the consumers' trust in relation to the contribution of organic farming to public goods. There is a need for research in this area, to generate knowledge on future directions and demands for the organic production.

Research and development needs

- The behaviour, values and preferences of the Danish consumers and new consumer segments; e.g. in relation to consumption patterns, choice of organic foods, perception of quality parameters, distribution channels, willingness to buy and pay for organic products, diet composition, and the need for experience-based communication and distribution channels.

- The consumers' perception and response to conflicting concerns in the organic production; e.g. between animal welfare through access to outdoor areas and the risk of increased environmental impact from outdoor animals; or between the climate impact from livestock production and the livestock's importance for management of nutrients in the farming system; or between the need for nutrient recycling from society to a sustainable organic production and the risk of supplying unwanted substances in wastewater and waste.
- Reliable communication and marketing of the added value of organic food production; e.g. how communication about the specific qualities of organic products and the contribution of organic production to public goods influence the consumers' perception of credibility, image and reputation of the Danish organic production.
- The consumers' perception of geographical qualities at local, national and international level; e.g. foreign consumers' perception of Denmark as a brand for organic food and as a gastronomy destination, as well as the Danish consumers' buying behaviour and perception of local food production and short supply chains.
- Methods and tools to strengthen collaboration, networking, product development and knowledge exchange across e.g. production, retail, catering sector/restaurants and consumers in relation to developing new sustainable production concepts like community supported agriculture, urban farming, vertical farming etc. in an organic context.





Organic farming – for a living

Organic farming must be an attractive profession both in terms of profitability, development opportunities and working conditions, and in terms of attracting new generations of organic farmers. Unstable and extreme climate-related production conditions challenge management as well as profitability, and at the same time, consumers and society demand more in terms of the sustainability of the food production and quality of the products.

The society's increasing focus on the local supply of food creates opportunities for organic farmers and aquaculture companies, for example in terms of higher crop diversity, new products, product development and local processing. Development of the organic sector must be sustainable for the farmers as well as for the society.

Research and development needs

- Climate smart and sustainable production systems that to a higher degree integrate more production forms and areas and exploit potential synergies with the aim to create resilience and financial stability as well as diversity in the production; e.g. in terms of different forms of intercropping, a higher degree of mixed farming with integration of animal and crop based food production, integration of nature buffer zones, trees and shrubs in the agricultural production, product development throughout the value chain, higher integration of the primary production in the value chain, as well as solutions for local processing and secured food supply. This includes integration of new dimensions in the management of the farm such as eco-tourism, social enterprising and care-farming.
- Collaboration processes and new forms of collaboration, integrated types of farming, forms of ownership and organisation of the agricultural production, as well as business models that support synergies between specialised productions in integrated systems within the farm, between farms and between farms and society. This includes opportunities for collaboration with consumer and social networks and exchange of knowledge as well as services between farmers and consumers.
- Management and financial decision-making tools designed for efficiency and profitability while addressing the specific challenges and possibilities of the organic sector. For example the need for expertise within several production areas on how to create synergy and coordination between the multiple production areas within the farm, adoption of climate change mitigating and sustainable systems, and a higher demand for locally produced food.
- Management and financial decision-making tools that integrates the challenges and potentials associated with new ways of organising the production, new management systems, new forms of collaboration and ownership, new business models and higher rural-urban integration.
- Technological solutions that support the above specific research and development areas, increase the functionality and make it feasible and attractive to implement financially as well as in terms of work load, working environment and conditions; e.g. robotics for crop and livestock production. This also includes establishment of a scientific basis for technology assessment, which can be used for the development of the organic regulations in compliance with the principles of organic agriculture, innovative use of data and ICT to support management of production processes, and for documentation of climate and environmental impacts.





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