TPorganics
European Technology Platform

STRATEGIC RESEARCH AND INNOVATION AGENDA FOR ORGANIC FOOD AND FARMING

Strategic Research and Innovation Agenda for Organic Food and Farming

Brussels, December 2014

Published by
TP Organics
Rue du Commerce 124
1000 Brussels
Belgium
Phone: +32 (0)2 808 79 91
Email: info@tporganics.eu
Website: www.tporganics.eu

Editors: Bram Moeskops, Eduardo Cuoco

Main authors: Alexander Beck, Eduardo Cuoco, Anna Maria Häring, Johannes Kahl, Chris Koopmans, Cristina Micheloni, Bram Moeskops, Urs Niggli, Susanne Padel, Ilse A. Rasmussen

Contributors: Lina Al Bitar, Monique Bestman, Susanne Bügel, Generosa Calabrese, Gianluigi Cardone, Ivana Cavoski, Francesco Ceglie, Ika Darnhofer, Lieve De Cock, Chris Gallasch, David Gould, Nicolas Gouze, Robert Hermanowski, John Hermansen, Machteld Huber, Johannes Ravn Jørgensen, Nadja Kasperciz, Jutta Kienzle, Antje Kölling, Edith Lammerts van Bueren, Giuseppe Lembo, Anne-Kristin Løes, Susan Løvstad Holdt, Rob Meijer, Monica Messmer, Gereon Meyer, Frank W. Oudshoorn, Flavio Paoletti, Krijn Poppe, Patrizia Pugliese, Jürn Sanders, Jan Tind Sørensen, Matthias Stolze, Carola Strassner, Wijnand Sukkel, Mette Vaarst, Nick van Eekeren, Vincenzo Verrasto, Petra Weiler, Raffaele Zanoli

English proofreading: Alastair Penny

Production support: Eva Berckmans, Laura Ullmann

Layout: Fuel. www.fueldesign.be

Acknowledgements:
TP Organics wishes to thank the coordinators of the different chapters (Urs Niggli, Bram Moeskops, Eduardo Cuoco, Susanne Padel, Anna Maria Häring, Chris Koopmans, Cristina Micheloni, Ilse A. Rasmussen, Johannes Kahl, Alexander Beck) for their tremendous efforts and excellent collaboration in developing the Strategic Research and Innovation Agenda.

Furthermore, we want to thank all the experts, members, stakeholder, SMEs and European Technology Platforms that provided feedback.

TP Organics gratefully acknowledges the feedback received from the Directorate-General Agriculture and Rural Development and from the Directorate-General Research and Innovation.

Finally, without the financial contribution of the supporters of TP Organics, this work would not have been possible. This support is very much appreciated.

This brochure was printed on Satimat FSC
Print run: 1,000

Illustrations:
Cover: ©BLE, Bonn/Foto: Dominic Menzler; Chapters 1, 3, 4, 5, 6, 8: IFOAM EU Group; Chapter 2: ©BLE, Bonn/Foto: Thomas Stephan; Chapter 7: EIP-AGRI Service Point

FSC www.fsc.org MIX From responsible sources FSC® C009267

CONTENT

EXECUTIVE SUMMARY

TP Organics is the European Technology Platform for organic food and farming, and for low-input agriculture. Established in 2008, it brings together small and medium-sized enterprises, larger companies, farmers, researchers, consumers and civil society organisations involved in the organic value chain from production, input and supply, to food processing, marketing and consumption. It identifies research and innovation needs and communicates them to policy-makers. The aim is to leverage the organic sector's contribution to sustainable farming and food production. Since 2013, TP Organics is officially recognised by the European Commission as one of 40 European Technology Platforms (ETPs).

TP Organics published its first Strategic Research Agenda in 2009. This proved very successful, as about a third of the research questions identified gained funding through the 7th Framework Programme for Research and Development (FP7) of the EU, or through transnational research programmes (ERA-Nets) and national research projects.

With the end of the 7th Framework Programme and the start of the new EU Framework Programme for Research and Innovation, Horizon 2020, TP Organics decided to revise its research agenda. This new Strategic Research and Innovation Agenda is the product of an intensive participatory process, which lasted for a year and a half and benefited from three consultations. First of all, an online consultation for members and stakeholder that attracted more than 300 responses. Secondly, a consultation to assess the relevance of the topics with regard to international cooperation. The third consultation aimed to get feedback from other ETPs. A detailed description of the development process of the Strategic Research and Innovation Agenda is given in Chapter 1.

Chapter 2 of the Agenda outlines TP Organics' vision for sustainable organic food and farming systems, which provides a framework for the research and innovation questions outlined in the subsequent chapters. The vision itself is divided according to three themes:

- **Empowerment of rural areas:** organic farming and food systems support crucial empowerment in rural areas
- **Eco-functional intensification:** this enhances the productivity, stability and resilience of agro-ecosystems
- **Food for health and wellbeing:** high quality foods are the basis for healthy diets, wellbeing and quality of life

While most of the topics in the Strategic Research and Innovation Agenda simultaneously support the organic sector and contribute to more sustainable approaches in mainstream food production, some also target the specific needs of the organic sector. This reflects the fact that the organic sector operates in its own special market and has to comply with specific EU regulations. In the light of the revision process of the organic regulation these specific research needs have gained pertinence in recent months. These specific topics are dealt with together in Chapter 3.

The research questions pertaining to the three themes of TP Organics' vision are described in Chapters 4 to 6. Chapter 7 outlines specific priorities for the Focus Groups of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). Here, the task is not so much to design new research projects, but rather to take stock of existing knowledge, promote dissemination and implementation, and identify research gaps that persist. The Agenda ends by drawing a number of conclusions in Chapter 8. These include a call for 10% of the Horizon 2020 funds allocated to "Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy" (Societal Challenge 2) to be dedicated to organic food and farming systems. 10% reflects the share of agricultural land under organic management in the EU. Currently, 5.6% of EU agricultural land is organic, but the full potential is estimated at 15-20%.

The EU Organic Action Plan recognised the importance of research and innovation for the development of the organic sector. However, it lacks clear commitments. The Horizon 2020 Work Programme 2016/2017 will be the first opportunity for EU policy-makers to show ambition in promoting research and innovation for organic food and farming. Taking the Strategic Research and Innovation Agenda as a basis, TP Organics will provide input to the drafting of the 2016/2017 and future Work Programmes. It will also seek cooperation with other European Technology Platforms (ETPs) in order to jointly promote those topics that are of common interest.

Finally, the Agenda calls for a follow-up measure to the ERA-Net CORE Organic, which has been very successful in grouping together the smaller players of the organic research community, to deliver better research more efficiently.

OUTLINE OF TOPICS IN THE STRATEGIC RESEARCH AND INNOVATION AGENDA

Research and innovation to overcome the challenges of the organic regulation

- Supporting the development of a diverse organic sector through better farming policies, better certification and market data
- Ensuring consumer confidence in organic food and farming
- Alternatives to contentious inputs used in organic agriculture
- Availability of organic seeds – towards 100% organic seed
- Eco-efficient production of animal feed at local level
- Improving organic poultry systems
- Development of innovative systems for organic aquaculture
- Organic food processing concepts and technologies

Organic farming and food systems support crucial empowerment in rural areas

- Business models and labour dynamics of value addition through food and feed processing
- Strengthening the resilience and innovation capacities of the organic sector
- Agro-ecological and organic farming as means of improving food security and rural development in sub-Saharan Africa and South Asia

Eco-functional intensification enhances the productivity, stability and resilience of agro-ecosystems

- Improved ecological support functions
- Appropriate and robust livestock systems
- Innovative ICT tools for organic cropping systems
- Solutions for resource-efficient primary production, based on the "Internet-of-Things"
- Assessment and sustainability of new technologies for organic agriculture
- Ecological support in specialised and intensive plant production systems
- Breeding robust plant varieties and animal breeds

High quality foods are the basis for healthy diets, wellbeing and quality of life

- The contribution of the organic food system to sustainable diets
- Public health effects of organic food systems in Europe
- The effects of organic foods and foods of different quality on the risk and severity of allergies, and on the general health and wellbeing of children

TP Organics is convinced that these topics will support the sustainable growth of the organic sector, both in Europe and beyond, while leveraging the contribution of the organic sector to sustainable food security and fostering entrepreneurship and economic opportunities in rural areas. Increased investment in research and innovation for the organic food and farming sector has much to offer, not only regarding the design of more sustainable production systems, but also for the design of new and resilient business models and forms of cooperation among stakeholders across the value chain.

INTRODUCTION

TP Organics is the European Technology Platform for organic food and farming, and for low-input agriculture. Established in 2008, it brings together small and medium-sized enterprises, larger companies, farmers, researchers, consumers and civil society organisations active in the organic value chain from production, input and supply, to food processing, marketing and consumption. It identifies research and innovation needs and communicates them to policy-makers. The aim is to leverage the organic sector's contribution to sustainable farming and food production, and to advocate for greater research funding for organic and agro-ecological production. Since 2013 TP Organics is officially recognised by the European Commission as one of 40 European Technology Platforms (ETPs). This means TP Organics fully takes part in the structured dialogue on research policy and priorities with the European Commission and other ETPs.

TP Organics published its first Strategic Research Agenda in 2009, containing 61 research goals drawn up on the basis of a comprehensive stakeholder consultation. This proved very successful as about a third of the research questions identified gained funding through projects of the EU's 7th Framework Programme for Research and Development (FP7), or through transnational research programmes (ERA-Nets) and national research projects.

With the end of the 7th Framework Programme and the start of the new EU Framework Programme for Research and Innovation, Horizon 2020, TP Organics decided to revise its research agenda. The policy priorities have changed, with greater focus now placed on innovations with tangible impacts, rather than research for its own sake. Support for innovation has also become a fundamental part of the Rural Development Regulation, in particular through the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). This new policy instrument was designed to create linkages between Horizon 2020 and Rural Development Programmes. The aim is to promote multi-actor partnerships for more demand-driven innovation.

In March 2014, the European Commission published a legislative proposal for a new organic regulation, provoking an intense debate in the organic sector. Many concerns have been raised about the feasibility of the proposed regulation, but it is also true that more efforts are needed to ensure consumer confidence in organic products. Support is needed for specific research and innovation activities in order to help organic producers meet the highest sustainability expectations. TP Organics therefore welcomes the Organic Action Plan, which the European Commission published together with the legislative proposal. This includes a chapter on specific support for the development of the organic sector through research and innovation.

While the organic sector does indeed have specific research and innovation needs, most of the topics covered in this Strategic Research and Innovation Agenda are intended both to support the development of the organic sector and to contribute to more sustainable approaches in mainstream farming and food production, not only in terms of designing more resilient and resource-efficient production systems, but also for the design of new business models and forms of cooperation among stakeholders across the value chain.

The new Strategic Research and Innovation Agenda is the result of an intensive participatory process, which lasted for a year and a half and benefited from an online consultation for members and stakeholders that attracted more than 300 responses. In addition, other ETPs as well as international cooperation partners were invited to provide feedback. TP Organics would like to thank all those who participated in the consultations and the drafting of the topic descriptions. Chapter 1 describes the development process of the Strategic Research and Innovation Agenda in detail.

Chapter 2 of the Agenda outlines TP Organics' vision for sustainable organic food and farming systems, which provides a framework for the presentation of the research and innovation questions in the subsequent chapters. Chapter 3 describes the specific research and innovation needs of the organic sector. Each of the three themes of TP Organics' vision – empowerment of rural areas, eco-functional intensification and food for health and wellbeing – and their related research questions have been allocated a separate chapter (Chapters 4 to 6). Chapter 7 then outlines a number of specific priorities for the EIP-AGRI, and the Agenda ends with an overview of the next steps to be taken in Chapter 8.

01

THE DEVELOPMENT PROCESS OF THE STRATEGIC RESEARCH AND INNOVATION AGENDA

Since its creation, TP Organics has operated according to the key principles of openness, transparency and awareness-raising, as all the European Technology Platforms (ETPs) are required to do (IDEA Consult, 2008). The same principles have guided the development of this Strategic Research and Innovation Agenda, which is the result of an intensive participatory process lasting a year and a half.

The first step was taken at the Stakeholder Forum of TP Organics in June 2013, where an exploratory discussion on emerging trends and research needs took place. In autumn 2013, TP Organics launched a call for experts willing to contribute to the drafting of the document. Initially, more than 30 experts volunteered, including researchers and people involved in practical work in all areas of the value chain. Ultimately, more than 40 experts contributed over the duration of the process.

Based on the outcomes of the discussions in June 2013, the expert team started drafting the first topic descriptions. These were then discussed at a workshop at BioFach in February 2014 and again at the TP Organics Stakeholder Forum of 1 July 2014. These events brought together policy-makers, experts and businesses. The same day as the Stakeholder Forum, TP Organics and its national platforms launched an online consultation in four languages (English, Spanish, Italian and Dutch). Members, stakeholders and organic SMEs were asked to prioritise the topics proposed by the expert team, and to add missing ones. More than 300 responses were received. In September 2014, the outcomes of the Stakeholder Forum and the online consultation were processed. A final selection of topics to be covered by the Strategic Research and Innovation Agenda was made. Throughout September experts and the TP Organics Secretariat worked intensively to prepare the advanced drafts by the beginning of October. These were used for two other consultations, one to assess the relevance of the topics with regard to international cooperation, and one to seek cooperation with other ETPs.

First, international partners were asked to assess the relevance of the proposed topics for their region. Questionnaires were prepared for the (non-European) Mediterranean region, West Africa, Southern Africa, East Africa, Central Africa, South America and North America. To broaden the reach of the consultation, cooperation was established with the Platform for African-European Partnership on Agricultural Research for Development, the Mediterranean Organic Agriculture Network and the International Centre for Advanced Mediterranean Agronomic Studies. Members of the platform, such as AgriBioMediterraneo and APRODEV, disseminated the consultation too. The questionnaire revealed strong interest in the Strategic Research and Innovation Agenda, especially from African and non-European Mediterranean countries.

Secondly, an assessment was made of which topics could be of interest for cross-technological cooperation with other ETPs (see Table 1.1). These topics were sent to the respective ETPs, along with a request that they send feedback and join in efforts to promote the topics. This consultation resulted in one common topic, namely “Solutions for resource-efficient primary production, based on the Internet-of-Things” which was developed in cooperation with the European Technology Platform on Smart Systems Integration (EPoSS). In addition, exploratory discussions took place with the Farm Animal Breeding and Reproduction Technology Platform (FABRE TP) and the European Robotics Technology Platform (euRobotics).

TP Organics will continue to seek cooperation with other ETPs, in particular with regard to the preparation of the next Horizon 2020 Work Programmes. TP Organics attaches great importance to working together with other sectors, since sustainable food and farming systems can only be achieved if all knowledge is brought together.

Finally, from October until December 2014, the expert team and the TP Organics Secretariat worked intensively to finalise the document, thereby taking into account all comments received during the consultations, as well as ad hoc feedback from experts on specific topics.

OPPORTUNITIES FOR COOPERATION BETWEEN TP ORGANICS AND OTHER EUROPEAN TECHNOLOGY PLATFORMS (ETPs)

Topics, classified according to themes of Horizon 2020, Societal Challenge 2	European Technology Platforms
Sustainable agriculture and forestry	
Improving organic poultry systems (see p. 24)	ETPGAH FABRE-TP
Appropriate and robust livestock systems (see p. 35)	ETPGAH FABRE-TP
Innovative ICT tools for organic cropping systems (see p. 36)	euRobotics Manufuture
Solutions for resource-efficient primary production, based on the "Internet-of-Things" (see p. 36)	EPoSS
Ecological support in specialised and intensive plant production systems (see p. 38)	WssTP
Breeding robust animal breeds (see p. 39)	FABRE-TP
Ensuring consumer confidence in organic food and farming (see p. 20)	EPoSS Food for Life
Sustainable, competitive agri-food sector	
Organic food processing concepts and technologies (see p. 25)	Manufuture Food for Life
Public health effects of organic food systems in Europe (see p. 44)	Food for Life
Unlocking the potential of aquatic living resources	
Development of innovative systems for organic aquaculture (see p. 24)	EATIP FABRE-TP

EATiP - European Aquaculture Technology and Innovation Platform
EATiP is dedicated to developing, supporting and promoting aquaculture and, especially and specifically, technology and innovation in aquaculture in Europe.
http://www.eatip.eu

EPoSS - European Technology Platform on Smart Systems Integration
EPoSS is an industry-driven policy initiative, defining R&D and innovation needs as well as policy requirements related to Smart Systems Integration and integrated Micro- and Nanosystems.
http://www.smart-systems-integration.org

ETPGAH - European Technology Platform for Global Animal Health
ETPGAH provides a mechanism for focusing and prioritising the research that ultimately delivers new or improved tools such as veterinary vaccines and diagnostic tests for animal health.
http://www.etpgah.eu

euRobotics - European Robotics Technology Platform
euRobotics aims to promote excellence in robotics by providing many networking opportunities to its members from both industry and academia, to exchange knowledge within the robotics community and to shape the future of robotics in Europe through cooperation between all sides.
http://www.eu-robotics.net

FABRE-TP - Farm Animal Breeding and Reproduction Technology Platform
FABRE-TP tackles major issues concerning sustainable animal breeding and reproduction in Europe, and taking into account what is happening in the developing world.
http://www.fabretp.info

Food for Life
ETP "Food for Life" addresses innovation in the EU food and drink industry.
http://etp.fooddrinkeurope.eu

Manufuture - ETP Future Manufacturing Technologies
The mission of the ETP Manufuture is to propose, develop and implement a strategy based on research and innovation, capable of speeding up the rate of industrial transformation to high-value products, processes and services.
http://www.manufuture.org

WssTP - Water Supply and Sanitation Technology Platform
WssTP is the European Technology Platform for Water. It strives to promote coordination and collaboration of research and innovation in the European water sector, improving at the same time its competitiveness.
http://wsstp.eu

02

VISION FOR SUSTAINABLE ORGANIC FOOD AND FARMING SYSTEMS

Coordinators:
Urs Niggli
Bram Moeskops

2.1 FUTURE CHALLENGES FOR AGRICULTURE

Since the World Summit on Food Security, hosted by the FAO in 2009 (FAO, 2009a), the political and scientific debate on the future of agriculture has focused on how to increase agricultural production and productivity without adversely affecting natural resources. This question is often addressed through the concept of "sustainable intensification" (The Royal Society, 2009; Buckwell et al., 2014) or sometimes "ecological intensification" (FAO, 2009b; Bommarco et al., 2013). In its first Strategic Research Agenda (Schmid et al., 2009), TP Organics developed the concept of "eco-functional intensification", which means improving yields and productivity through the more efficient use of natural resources and processes, improved nutrient recycling techniques, and innovative agro-ecological methods for enhancing the diversity and health of soils, crops and livestock. More recently, the European Commission has coined the phrase "Sustainable Food Security" in the Horizon 2020 Work Programme 2014-2015 (European Commission, 2013) as an overarching concept for research investment in agriculture. Sustainable Food Security means ensuring the availability of, and access to sufficient safe and nutritious food, while sustainably managing natural resources.

These differing concepts show that the future course for agriculture – whether to focus rather on sustainability or intensification – is still open to debate. The discussion is also reflected in the 3rd foresight exercise of the Standing Committee on Agricultural Research (EU-SCAR, 2011), which identified two competing narratives: "productivity" and "sufficiency". The productivity narrative stresses the need to boost agricultural production in order to meet the rising demand of the growing world population. The sufficiency narrative emphasises the carrying capacity of the earth, which is unable to support further increases in consumption and production. Adherents of this view rather support the design of agro-ecosystems that require low levels of external inputs and the reduction of per capita demand through structural changes in food systems. Both perspectives have been recognised in the Strategic Implementation Plan of the European Innovation Partnership for Agricultural Productivity and Sustainability (High-Level Steering Board of EIP-AGRI, 2014).

Recently, the Rural Investment Support for Europe (RISE) Foundation published a report on sustainable intensification (Buckwell et al., 2014). While the report still assumes that some increase in production is needed, it stresses that sustainable intensification can also mean an increase in environmental services provided by the farm. It claims that, for Europe, "sustainable" is the more important word in the phrase, and suggests that sustainable intensification is not primarily about using more fertilisers, pesticides and machinery per hectare, but about the development of much more knowledge-intensive management systems. It also states that a stepped reduction is now needed in the negative environmental impacts of agriculture. Such impacts have already been reported by many studies. The Millennium Ecosystem Assessment (2005) formed a scientific and political consensus that the intensification of food, feed, fuel and fibre production has drastically endangered the functioning of ecosystems. Agriculture has contributed much to crossing several of our planet's limits (Rockström et al., 2009). For example, the growth in fertiliser use in modern agriculture has caused us to exceed sustainable limits for the rate of human interference with the global nitrogen cycle. Agriculture has also contributed to exceeding the limits for climate change, the phosphorous cycle, global freshwater use and land use change.

Related to the discussion of "productivity" versus "sufficiency", is the question of "resilience". Europe faces major systemic risks to the supply and quality of food, in the light of climate change, natural hazards, energy scarcity, limited availability of natural resources (fertile soils, water...), population growth, and unsustainable dietary patterns. Therefore, there is an urgent need to develop more resilient food systems and value chains.

Resilient systems are able to absorb larger disturbances (e.g. due to climate change, loss of biodiversity, market volatility) without fundamentally changing the way in which they work. Resilient systems are able to adapt, to renew, to self-organise and learn.

Research has revealed that resilience to climate disasters is closely linked to the level of on-farm biodiversity (Lin, 2011). Research suggests that agro-ecosystem performance and stability are largely dependent on the level of plant and animal biodiversity present in the system and its surrounding environment (Altieri & Nicholls, 2004). This prompts the conclusion that ecologically based management strategies which break the dominance of monocultures in favour of landscape heterogeneity might provide a robust path to increased productivity, sustainability and resilience of agricultural production (Altieri, 2002; De Schutter, 2010; Altieri et al., 2014). These insights have recently been promoted successfully at the international level by the agroecological movement, e.g. through the International Symposium on Agroecology for Food Security and Nutrition (FAO, 2014). There are strong overlaps between organic agriculture and agroecology. Both promote a "closed system" approach which minimises external inputs; they use multiple and diverse crops and/or animals, and they rely on biological processes to build soil fertility and control pests and diseases (Bellon et al., 2011). Both tend to favour more direct links with their customers and to engage with social movements.

Finally, Europe faces the challenge of the deteriorating economic viability of its rural areas. Increasingly, farmers are experiencing economic difficulties that will endanger food security in the long run. Demographic factors are further accentuating this trend. Farmers are aging and inhabitants of rural areas are moving away to urban areas. Entry into the agricultural business is associated with high financial risks, not least because land prices have increased tremendously in many regions of Europe. In this regard, the multifunctional and multidisciplinary nature of organic farming is a great strength. A large proportion of organic farmers diversify their income sources and spread their risks through activities such as on-farm processing, direct sales or tourism and recreation facilities. As such they become important drivers for rural development. Strong agricultural knowledge and innovation systems are also important to support the competitiveness of farms and other businesses in rural areas. There is a great need for entrepreneurial support, new business models for alternative value-chain organisation, and increased connections between actors (producers and consumers, researchers and policy-makers). In this respect, the increasing interest of citizens in local/regional products and environmentally friendly food products offers new opportunities for the development of new rural-urban partnerships.

To summarise, the challenges agriculture is facing call for completely new concepts of food production and consumption. According to the Millennium Ecosystems Assessment (2005), the challenge of reversing the degradation of ecosystems while meeting the increasing demand for their services, will require significant changes in policies, institutions and practices. This also means that new approaches are needed in research, knowledge creation and learning (IAASTD, 2008).

2.2 CAN ORGANIC AGRICULTURE RESPOND TO FUTURE CHALLENGES?

THE STRENGTHS OF ORGANIC AGRICULTURE IN RESPONSE TO FUTURE CHALLENGES

Organic agriculture is an example of a well-developed food and farming system that **puts into practice the sufficiency narrative**. Compared to conventional agriculture, it is less reliant on external inputs. For example, organic farming bans the use of energy-intensive nitrogen fertilisers and restricts the use of phosphorous, both of which depend on finite mining activities. While yields can be 20% lower in organic systems (Mäder et al., 2002; De Ponti et al., 2012; Ponisio et al., 2014), it is possible to reduce inputs of fertiliser and energy by 34–53%, and the use of plant protection products by 97% (Mäder et al., 2002). This means organic farming systems are very resource-efficient. Moreover, organic consumers are generally better aware of the ecological footprint of the food they consume, and they undertake different efforts to reduce it.

Organic farms are multi-functional. Organic farmers allocate their limited resources, such as labour, land, internal inputs or farm infrastructure, to different activities and try to optimise the performance of the whole farm.

Organic farmers provide more public goods. Nutrient losses on their farms are lower, they reduce eutrophication while building up soil fertility, sequestering carbon, increasing above- and below-ground species diversity and stopping biodiversity loss in semi-natural habitats and conservation areas (Niggli, 2014). Organic farming is more than an economic model or niche market. It represents a value-based approach to agriculture. Organic agriculture movements are united in the International Federation of Organic Agriculture Movements (IFOAM), which has defined four principles of organic agriculture: "health", "ecology", "fairness" and "care".

The origins of organic agriculture lie in co-innovation by farmers and scientists. By contrast, the adoption of sustainable farming practices in conventional agriculture is often impeded by the insufficient integration of farmers and the diversity of their farms in mainstream research projects (Leeuwis, 1999). Research is too often dominated by scientists. Most of the more recent concepts therefore emphasise co-innovation that involves farmers, farm advisers and scientists on an equal basis (Dogliotti et al., 2014). Significant and complex changes in farming practice cannot result from a "take it or leave it" package of blue-print solutions or technological fixes. Farmers themselves must be involved in all stages of the innovation process in order to ensure relevance and applicability of the developed solutions in different environments. These are preconditions for the widespread adoption of any new ideas by farmers. Often, for many practical problems, farmers are themselves the main source of innovation. Active knowledge creation has superseded passive technology transfer (Koutsouris, 2012). To achieve better responses to global environmental changes, more open knowledge systems are required. It is precisely this kind of open and inclusive knowledge systems that underpin innovation in organic agriculture, where the farms are creative living laboratories.

THE CHALLENGES FACING ORGANIC AGRICULTURE

Critics of organic agriculture argue that **organic agriculture may have lower yields** and would therefore not be able to feed the world. A recent meta-analysis found that organic yields are 19.2% lower than conventional yields (Ponisio et al., 2014).

This is a similar figure as estimated by De Ponti et al. (2012), but smaller than the yield gap of 25% estimated by the meta-analysis of Seufert et al. (2012). These meta-analyses showed that only the best management practices (best control of weeds, diseases, and pests, crop rotations, polycultures) can result in yields comparable to those of conventional farms. Under favourable soil and climatic conditions, organic farming does not exploit the full yield potentials of modern varieties. On the other hand, much of the agricultural land in Europe is not suited to further intensification because of its inferior soil quality or temporary droughts (Buckwell et al., 2014). Furthermore, maximising single crop and/or livestock yields might be of subordinate importance in many cases. Optimising farm incomes rather than increasing yields is likely to be a better strategy for keeping rural areas attractive. High-input, high-output production systems often have low resilience and do not perform well in years with less favourable growing conditions (pest outbreaks, drought...). Organic systems tend to be more resilient and often produce stable yields over the long term, even under less favourable growing conditions. For regions in which subsistence farming predominates, organic agriculture even represents a major step towards intensification of food production and yield increase (Hine et al., 2008). Moreover, increasing food production is not the only means of achieving global food security. Access to food must be improved and should become fairer. Food loss and waste have to be reduced drastically and consumption habits need to become more sustainable.

Based on IFOAM's organic principle of "care", **several new technologies are excluded**, such as modern breeding and multiplication techniques or innovations in the field of molecular sciences. These bans are justified as precaution is needed whenever potential risks to human health, the environment and society cannot be excluded. Nevertheless, excluding certain technologies challenges the organic sector to develop innovative alternatives. On the other hand, the sector has a strong tradition of involving farmers and other practitioners in innovation processes, which means its innovations are often better adapted to the local conditions and can be taken up more easily by practitioners.

2.3 RESEARCH AND INNOVATION FOR SUSTAINABLE ORGANIC FOOD AND FARMING SYSTEMS

Based on the strengths and challenges described above, TP Organics has developed a vision for future research and innovation into organic food and farming, as well as agroecological systems in a broader sense. This vision is split into three themes: "empowerment of rural areas", "eco-functional intensification" and "food for health and wellbeing".

THEME 1:
ORGANIC FARMING AND FOOD SYSTEMS SUPPORT CRUCIAL EMPOWERMENT IN RURAL AREAS

In future, organic agriculture, food processing and eco-tourism will become important drivers of empowerment in rural economies. In many regions of Europe, organic agriculture will be the preferred farming system. A diversified local economy will attract people and improve livelihoods, particularly for small farmers and businesses, and for young entrants. This will halt or even reverse migration from rural areas to urban centres. Organic farm practices, animal welfare and a wide range of related green products and services (such as eco-tourism, renewable energy, ecosystem services, and mail-order and home delivery of food) will intensify the exchange between urban and rural populations and lead to new forms of partnership between consumers and producers.

Organic farming will motivate and reunite actors of sustainable food chains and will contribute to the attractiveness and unique quality of European landscapes.

THEME 2:
ECO-FUNCTIONAL INTENSIFICATION ENHANCES THE PRODUCTIVITY, STABILITY AND RESILIENCE OF AGRO-ECOSYSTEMS

In future, the availability of food and the stability of food supply will be markedly increased through eco-functional intensification. Food productivity based on non-renewable resources and off-farm inputs will become marginal. Knowledge among farmers about how to manage ecosystem services in a sustainable way will be much greater, and animal welfare and environmentally sound farming will underpin state-of-the-art food production. Organic farms will demonstrate how trade-offs between productivity and sustainability can be minimised. They will be the benchmark for the responsible and precautionary use of scientific progress in agriculture.

THEME 3:
HIGH QUALITY FOODS ARE THE BASIS FOR HEALTHY DIETS, WELLBEING AND QUALITY OF LIFE

In future, people will have more healthy and better balanced diets. Food and quality preferences will have changed: fresh and whole foods will be the ultimate trend. Food processing technology will meet the highest environmental standards and only minimally alter the intrinsic qualities of the food. Specific flavours and regional variations will be more appreciated than artificial flavours. Organic farmers, food processors and distributors will spearhead this trend towards higher food quality, better informed and less wasteful consumption of food, and the renaissance of authenticity and traditional foods.

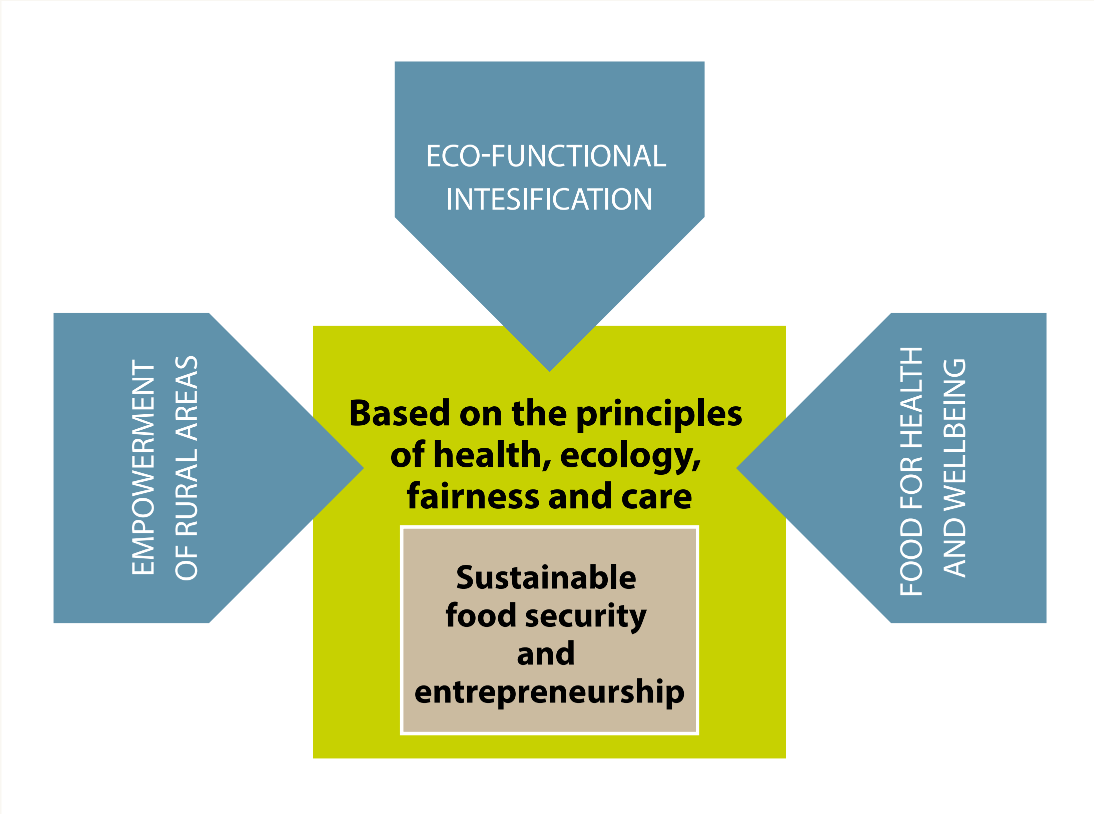


Fig. 2.1: TP Organics' vision for research and innovation into organic food and farming and agroecological systems

2.4 STRATEGIC RESEARCH AND INNOVATION AGENDA

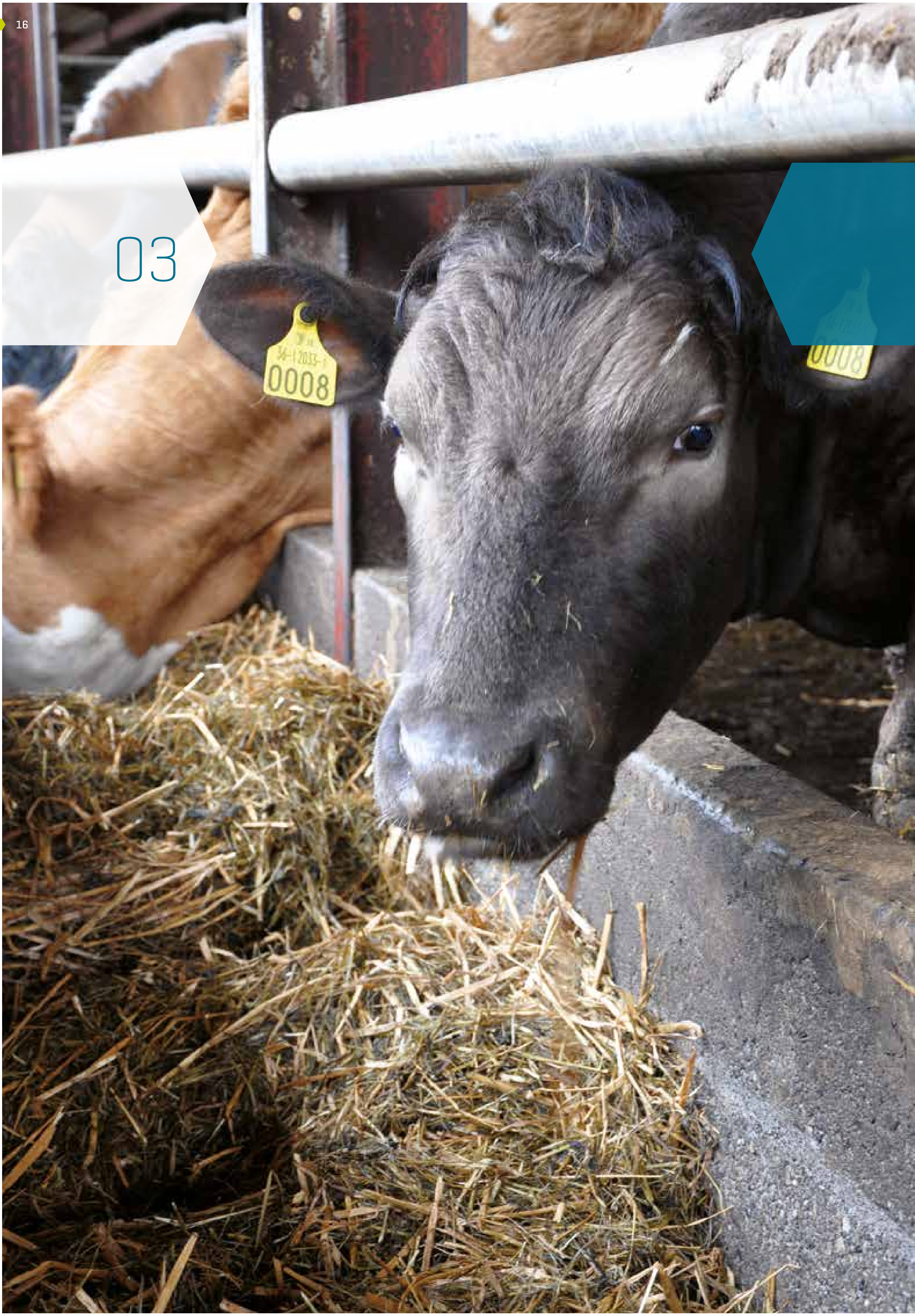
This vision, with its three themes, provides the framework for the research and innovation questions outlined in the following chapters of this Strategic Research & Innovation Agenda (Chapters 4 to 6). All the topic descriptions are structured in the same way: firstly the *specific challenge* is described, then further details on the aims of the research are given in the *scope*, and finally the *expected impacts* of the research is listed.

Together, the proposed topics will support the sustainable growth of the organic sector, while leveraging its contribution to sustainable food security and entrepreneurship in rural areas. While the focus is clearly on the European organic sector, the proposed research and innovation questions have relevance far beyond Europe. In particular, consultations during the preparation of this Agenda have revealed clear overlaps with the needs of the organic food and farming sector in African and non-European Mediterranean countries.

While most of the topics should both support the organic sector and contribute to more sustainable approaches in mainstream farming and food production, some do target the particular research needs of the organic sector that result from specific EU regulations applicable to the organic sector. These specific topics are dealt with together in Chapter 3.

In some areas, a lot of useful knowledge already exists and innovative practices have been introduced. Here the challenge is not so much to design new research projects, but rather to take stock of the existing knowledge, promote its dissemination and application, and to identify remaining research gaps. The Focus Groups of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI) offer the right instrument for this. Priorities for these Focus Groups are listed in Chapter 7.

03



RESEARCH AND INNOVATION TO OVERCOME THE CHALLENGES OF THE ORGANIC REGULATION

Coordinators:
Bram Moeskops
Eduardo Cuoco

The production and marketing of organic food is regulated at EU level by Council Regulation EC/834/2007. This safeguards consumer confidence in organic products and ensures fair competition between operators in the different Member States. With the publication of a legislative proposal for a new organic regulation in March 2014, the European Commission initiated a major revision process for the rules governing the organic sector (European Commission, 2014a). While the outcome of the process is uncertain, the initial proposal foresees the phasing out of several derogations in the near future. These changes would oblige organic farmers, for example, to use only organic seeds and locally grown organic feed. If they are to adapt to the new rules while still striving to meet the highest expectations of sustainability, organic operators will need strong support – including support for research and innovation.

Given the fact that the organic sector operates in its own special market and has to comply with specific EU regulations, it has specific research and innovation needs which are not shared by other parts of the food and farming sector. This chapter presents these specific research questions. Many of them correspond to the needs identified in the Organic Action Plan, which the Commission published together with the legislative proposal (European Commission, 2014b).

This chapter addresses the following topics:

- Supporting the development of a diverse organic sector through better farming policies, better certification and market data
- Ensuring consumer confidence in organic food and farming
- Alternatives to contentious inputs used in organic agriculture
- Availability of organic seeds – towards 100% organic seed
- Eco-efficient production of animal feed at local level
- Improving organic poultry systems
- Development of innovative systems for organic aquaculture
- Organic food processing concepts and technologies

3.1 SUPPORTING THE DEVELOPMENT OF A DIVERSE ORGANIC SECTOR THROUGH BETTER FARMING POLICIES, BETTER CERTIFICATION AND MARKET DATA

SPECIFIC CHALLENGE

Organic farming contributes to a number of policy goals such as high-quality food production and the production of other goods and services, such as ecosystems services. However, the sector faces the challenge that demand exceeds supply for several products. The number of new entrants has declined, small farmers are deterred by the cost of certification and there is a lack of reliable data on the organic market. Filling these gaps would enable producers and other businesses to take advantage of the opportunities the sector offers. To develop coherent and well-targeted support programmes, a better understanding is needed of the obstacles affecting the sector, and of the potential synergies between different policy instruments.

SCOPE

Obstacles to organic farming arise in various areas. They include technical issues and access to know-how, access to markets and/or organic premiums, the cost of organic inputs and certification, policy support, access to land, perceived higher labour requirements with potentially negative impacts on competitiveness, and a variety of social issues. These problems can be tackled with a variety of support instruments. Projects should address one of the following issues.

A. Developing the organic farming policies of the future

A comprehensive and systemic framework for the analysis of interactions along the whole supply chain and in specific regions can be used to derive recommendations on targeted support for the development of the sector. Projects should address the complex interactions and dependencies between different policy support instruments, under different organic sector development trajectories, and with different farm types and regional conditions. They should consider obstacles to, and support for organic farms under the Common Agricultural Policy (CAP), any reasons that might exist for leaving the organic sector, and how to increase the use of organic products in public procurement.

There is also a need to improve the means used to monitor the effectiveness and efficiency of organic farming support policies, and to develop and test distinct policy mixes. Monitoring should make use of existing data sources and tools, while new approaches should also be developed for evaluating the outputs, results and impacts of organic farming policy support. Particular attention should be paid to increasing the attractiveness of organic farming for small farms, for young entrants and for SMEs in the food manufacturing sector.

A multi-actor and multi-dimensional approach should be adopted, which considers the views of farmers and their suppliers, as well as food manufacturers, distributors and policy-makers.

B. Improving organic certification

Projects should develop proposals for group certification in Europe, which should reduce the cost of certification, in particular for small operators. Projects should also explore alternative ways in which the third-party certification process can safeguard improvements made towards the aspirational principles and objectives of organic farming (in relation to sustainability, environmental impact and animal welfare) by operators along the whole supply chain. Risk-based approaches to certification should be considered, as should international developments in sustainability assessment for food and agriculture, and the recognition of organic certification in public procurement criteria for food and catering services.

A multi-actor approach involving (groups of) farmers, supply chain actors and certification bodies in pilot projects is essential. The experience of other quality label programmes and existing tools should be utilised.

C. Better market and benchmarking data to support the further development of the organic sector

Uncertainty regarding organic markets and prices, and about the financial performance and resource requirements of organic farming is a major deterrent to new entrants along the supply chain in the organic sector. Data of good quality are needed to inform effective and rapid decisions, at both governmental (policymaking) and enterprise or farm level.

There is a need to collect, analyse and disseminate data on production volumes and the values of key products, as well as data on the domestic markets, exports and imports, and prices at farm and retail level. Statistical information should be expanded for the whole EU, the Associated Countries, the EFTA countries and selected third countries.

Big data and marketing analytics represent opportunities to improve the statistical analysis of market data, to enhance and harmonise data quality, and to develop an integrated platform on which large volumes of statistical information can be shared reciprocally.

Another challenge is the need to understand better how value is produced at farm level and along supply chains (including direct sales). Critical questions like economies of scale, benefits of specialisation vs. diversification, effects of knowledge and skills required, changes in labour requirements, work satisfaction and social and gender dynamics should be analysed. Decision support tools and planning data for different farm types, management strategies, geographic areas and site conditions should be developed. These tools should be used together with data mining and other marketing analytics to provide specific business intelligence for the development of selected organic supply chains. Such tools could serve similar needs in conventional farming.

A multi-actor approach should be adopted, with close collaboration between farmers, consultants, supply chain actors (SMEs), researchers, and public and private bodies that publish organic market data. Activities should build on the outcomes of the "Organic Data Network" project, funded by the European Commission under FP7, and should cover Associated Countries and non-European Mediterranean countries, as well as selected International Cooperation Partner Countries (ICPC) from Asia and Latin America.

D. Increasing the share of organic products in public procurement

Increasing the use of organic food in public procurement is one way to develop the sector, but it is often difficult to obtain all the organic ingredients for a wide range of dishes. The use of organic food in public procurement therefore requires some flexibility. Proposals should explore ways of increasing the use of organic food in public procurement. They should consider provisions for the use of organic food in the Green Public Procurement criteria for food and catering services of the EU, and the experiences gained through successful examples in Member States with national or private standards in this area. The project should draw on the results of the JRC study "Mapping of National School Food Policies" and on the first results of the Horizon 2020 call on "Sustainable food chains through public policies: the cases of the EU quality policy and of public sector food procurement".

Recommendations should be developed on introducing simplified innovative certification procedures for catering, on raising the level of recognition of organic products in the Commissions' Green Public Procurement criteria for food and catering services, and on how to develop information and meal promotions that support organic products or menus.

This requires a multi-actor approach involving large-scale caterers and control bodies certifying catering businesses under national or private rules.

EXPECTED IMPACT

- Transparency and confidence in the opportunities offered by the organic sector are increased, and strategies are developed to overcome existing constraints
- Targeted, multi-objective policy instruments and policy mixes for organic farming support are developed that contribute to both sector development and to the delivery of public goods
- The credibility of the organic food and farming sector is strengthened and the contribution of organic farming to sustainable rural development throughout Europe is enhanced
- Consumer confidence in organic certification is improved, while the cost of certification is reduced
- The transparency of the organic market is improved
- There is greater clarity on business opportunities in the organic sector
- The labour dynamics are better understood, resulting in improved competitiveness of organic businesses
- There is increased use of organic products in public procurement

3.2 ENSURING CONSUMER CONFIDENCE IN ORGANIC FOOD AND FARMING

SPECIFIC CHALLENGE

Organic farming relies on the willingness of consumers to pay a premium for organic products. Most consumers have however little understanding of the production systems behind the food they eat. The increasing divide between consumers and food producers is threatening people's confidence in the integrity of the expanding organic supply chains and undermining their willingness to pay a price premium. The European Organic Action Plan of the European Commission (2014b) therefore considers as a major challenge the need to respond to growing consumer demand without putting at risk consumers' confidence in the integrity of organic food and farming. However, it is not well understood how the consumers' different needs can be addressed while reconnecting them with sustainable food production, nor how confidence in organic food production can be assured.

A particular challenge is the fact that organic farming certification covers credence attributes which cannot be tested for in the final product. Such attributes have to be verified during the production process, and they need to be considered when the quality and integrity of organic products are evaluated. Finally, the quality of the food is a central argument for European consumers who buy organic products. Therefore, there is a need to develop and apply a systematic quality analysis procedure for organic food.

SCOPE

A. Understanding consumer attitudes towards the sustainability of organic products

Projects should aim to achieve a better understanding of the information available to consumers regarding organic food and its sustainability, and what role market stimuli and institutional information have in building consumer confidence in the sustainability of organic products. A number of studies have identified environmental values as being among the drivers of organic food consumption. It will be necessary to analyse how consumers acquire information about product sustainability, how this is interpreted and integrated in the information on organic products, and how much the environmental issues matter in actual food choices.

In addition, projects could focus on how consumers understand sustainability and whether their perceptions of organic agriculture have changed in the last 10 years, and how this relates to other food certification schemes (such as carbon footprints, fair trade, animal welfare, local farming, direct sales labelling schemes and other emerging sustainability labelling initiatives). Research should explore and consider the various strategies that consumers adopt to negotiate between potentially conflicting ethical choices in their daily decisions when buying food.

B. Reconnecting consumers with food production

The aim here is to develop better models for improving consumers' connection with food production, which should result in consumption choices that foster sustainable food systems. Examples of innovative food production and communication models that seem to reconnect consumers with food production, such as community gardens, urban agriculture, Community Supported Agriculture, etc. should be analysed in detail in terms of: a) the motivations and attractiveness of such approaches to consumers, b) successful processes, c) food communication strategies, and possibly d) urban food policies designed to improve consumers' relationships with food production. A range of innovative food production and communication models, social environments and policy environments should be taken into account. Special emphasis should be placed on diversified food and farming systems, such as organic and high nature value farming, and on alternative and regional models for organising food supply systems, which are assumed to be more sustainable than other systems. Public procurers for schools, healthcare facilities, universities and community organisations should be involved, as well as those who source food for private business dining facilities. Similarly, social movements interested in sustainable food should contribute, as these are currently very active and have the potential to stimulate discussion in society about sustainable food systems.

C. Assessing quality of organic food and integrity of the organic food chain

Organic food quality is described in terms of organic integrity, the true nature of the product, the use of natural substances and vital qualities. From the perspective of consumers and market chains, there is a need to select and/or develop verifiable indicators to evaluate these attributes. Once the indicators have been chosen, the parameters and testing methodology will need to be selected. Shortcomings in the methodology should be identified. Instead of organic versus non-organic comparisons, examples should be selected from best practice in farming and processing. These should be characterised by process and product criteria, based on a wide range of different organic quality parameters. The quality criteria should be based on consumer expectations, and should reflect the value added throughout the organic food supply chain.

A systematic analysis of factors influencing food quality would allow operators to improve their quality management. Successful implementation will depend on the further development of quality analysis methods for different product groups (e.g. milk, meat, fruit and vegetables, bakery products). The instrument should be developed in collaboration with the industry and experts from certification bodies. This will allow broad dissemination of the methodology and development of concrete recommendations.

D. Increasing the transparency of food supply chains

In this area, projects should enhance the confidence shown by consumers in the integrity of organic products by providing them with transparent, reliable and relevant information about organic supply chains, using ICT tools. Sustainability assessment and consumer research should be linked in an interdisciplinary effort that involves researchers and SMEs working with information technologies, traceability and quality assurance systems. Consumer research should be employed to gain a deeper understanding of how and when consumers use such schemes, and what factors they perceive as relevant in their evaluation of the integrity of organic supply chains.

ICT tools could be developed, allowing consumers to access information about all the actors in the supply chain for a specific product, and their respective sustainability performance, using codes published on product packaging (e.g. QR Code, bar code, internet link). For this, sustainability assessment tools tailored to the information required for B2B and B2C communication could be developed on the basis of existing and validated sustainability assessment indicator sets and approaches. In this context it is worth considering the opportunities afforded by new media (social networks, smart phone apps).

The project should lead to a better understanding of how consumers gather and use information, and what role ICT-supported information systems can play in building consumer confidence in the sustainability of organic products. The relationships with other food information, certification and labelling initiatives (e.g. carbon footprint, fair trade, animal welfare, local farming) should be explored.

EXPECTED IMPACT

- Improved sustainability, quality and certification of organic production along entire supply chains
- Innovative solutions that improve consumer confidence in the integrity of organic supply chains, and solutions to promote the added value of organic products
- Collaborative development of practical systems, tools and communication strategies aimed at improving the integrity of organic supply chains on the one hand and supporting organic market development on the other
- Improved strategies for communicating sustainability issues
- Development of policy recommendations on how to support more sustainable food systems, e.g. in an urban context

3.3 ALTERNATIVES TO CONTENTIOUS INPUTS USED IN ORGANIC AGRICULTURE

SPECIFIC CHALLENGE

In the last 20 years, the organic sector has continuously grown in the EU. Increasing practical knowledge as well as scientific research have enabled the quantity, quality and diversity of organic production to improve significantly. Specific improvements mean it is no longer necessary to use inputs that are not completely in line with organic principles. Nevertheless, there are still some inputs allowed under the EU organic regulations that are only accepted because there are, as yet, no economically viable alternatives.

The most controversial of these is the use of copper as a plant protection product. However, there is also an urgent need for alternatives to the use of mineral oils (for plant protection), to manure from conventionally raised livestock, to certain vitamins used in animal production, to the heating of greenhouses with fossil fuels, and to the use of sulphites and nitrates in food processing.

SCOPE

Projects should:

- Assess the actual need for contentious inputs, as well as the availability of alternatives to them (drawing on research and practice), either through changes in farming practice or the use of other inputs
- Propose recommendations for the phasing out of contentious inputs without damaging the competitiveness of the organic sector, whilst ensuring full respect for organic principles
- Assess production, types and formulation of contentious inputs, and define criteria for their acceptability.

Projects should contribute to fair, sustainable and implementable rules for the use of inputs in organic plant production, animal husbandry and processing. Activities should address different geographical and climatic conditions, and they should include Associated Countries and non-European Mediterranean countries.

EXPECTED IMPACT

- Fair, reliable and implementable rules on the use of inputs in organic production
- Improved assessment of the need for, and environmental impact of contentious inputs
- Identification of alternatives to replace contentious inputs. Better knowledge of alternatives will also allow a reduction of inputs in conventional agriculture
- Enhanced organic production, quality and stability

3.4 AVAILABILITY OF ORGANIC SEEDS – TOWARDS 100% ORGANIC SEED

SPECIFIC CHALLENGE

The EU organic regulation requires that seed and propagation materials used in organic farming are organically produced. This rule has been in force since 1991, but several bottlenecks make compliance very difficult. Therefore, a derogation regime has been established which varies between Member States. This results in unfair competition and makes seed producers hesitant to invest in organic production.

The proposal for a new EU organic regulation (European Commission, 2014a) includes the end of the derogation regime, which would force organic farmers to use exclusively organic seeds. Paradoxically, however, ending the derogation regime would reduce the diversity of varieties that organic farmers can use, with a negative impact on the sustainability and productivity of organic farming.

The organic movement is willing to take further steps towards the 100% use of organic seeds. But for this to happen, a sufficient supply of organic seed is needed, offering a broad range of crop types and varieties with different characteristics that fit organic systems in different ecological and climatic zones, and which suit different markets and market segments. The challenges lie in developing a gradual approach to achieving 100% use of diversified organic seeds, and in ensuring a level playing field for all the stakeholders involved (farmers, processors, traders, retailers, seed producers, food trade chains, etc.). This requires cooperation at both national and EU levels.

SCOPE

Projects should contribute to fair and sustainable rules regarding the use of organic seed. This can be achieved by:

- Surveying the availability of organic seed in different Member States and identifying the constraints on increased supply
- Developing an EU-wide database which harmonises the registration of seeds, but takes account of regional specificities and acknowledges that some seed is available in some regions only
- Assessing critically the feasibility of achieving 100% use of organic seeds for all species grown in organic agriculture
- Developing a strategy to increase the production of organic seed, both by seed companies and on farms
- Launching variety trials in different Member States to evaluate potentially valuable varieties
- Identifying remaining gaps and launching long-term breeding programmes for organic farming
- Sharing information and organising exchanges and training modules to make farmers and growers aware of the importance of the use of organic seed and to involve them actively in the development of the organic seed sector, thereby taking their needs into account.

EXPECTED IMPACT

- Feasible approaches to achieving 100% use of organic seed
- Collection and exchange of practical, regulatory and scientific knowledge to achieve an extensive seed assortment in organic farming
- Efficient multiplication methods and networks of farmers and breeders for the production of organic seed and genetic material, adapted to organic systems
- Enhanced quality and stability of organic production

3.5 ECO-EFFICIENT PRODUCTION OF ANIMAL FEED AT LOCAL LEVEL

SPECIFIC CHALLENGE

A key objective of organic farming is the closing of nutrient cycles. Nevertheless, recycling of nutrients (on farms or at a regional level) is difficult to achieve in large parts of the EU, mainly for economic reasons. To a large extent, feed and livestock production are concentrated in different regions, and animal feed (especially proteins) has to be imported from regions far away from where the animals are raised. This threatens both the sustainability of organic production as well as consumers' confidence.

The Commission's proposal for a new organic regulation (European Commission, 2014a) would significantly increase the proportion of feed that needs to come from the same farm or region. To enable the organic sector to comply with the expected new regulation, while living up to the highest expectations of sustainability, enhanced efforts are needed to increase the local production of feed crops and proteins. Greater knowledge of how to increase the local production of protein crops would also make the conventional animal sector, which currently depends on imports of protein feed from overseas, more environmentally sustainable and climate-smart and would increase its resilience.

Feed crops for all livestock species should be considered. However, special attention should be paid to proteins for organic poultry and piglets, since the exceptions under Council Regulation EC/834/2007, allowing the use of up to 5% conventional protein feed in these systems, would be cancelled in the Commission's proposed new organic regulation.

SCOPE

Projects should:

- Gather experiences and practical knowledge on innovative systems of feed production developed locally or regionally
- Develop innovative cropping systems (locally adapted) for the production of local/regional feed. These would include growing new crops and more adapted varieties of existing crops, and redesigning crop rotations and intercropping

- Develop innovative processing methods, including bio-refining, to convert crops and grassland forage into feed, which can be implemented at farm level or in local cooperative arrangements
- Further explore the use of alternative protein sources for organic livestock
- Disseminate the collected knowledge through a participatory process.

EXPECTED IMPACT

- Recommendations on the fair implementation of the organic regulation, concerning the production and use of organic feed
- Improved sustainability of both organic and conventional animal husbandry
- Development of new cropping systems for feed production, and the innovative use of crops, grassland forage, by-products and other potential protein sources, to be applied in the organic and conventional sector
- Support for local farming systems and economies driven by organic animal production

3.6 IMPROVING ORGANIC POULTRY SYSTEMS

SPECIFIC CHALLENGE

Organic poultry systems have become increasingly specialised. They have a narrow ecological base, which threatens their resilience. From the initial economic advantage of specialisation, they have become high-risk, low-profit systems. Specialised poultry systems are associated with high nutrient loads and environmental impact. Greater efforts are needed to improve the environmental and economic sustainability of organic poultry production, while ensuring animal health and welfare.

SCOPE

Poultry breeds should be monitored on their performance, health and welfare in several organic production systems and appropriate breeding strategies or programmes for improving animal welfare should be considered. As regards laying hens, the aim should be to reduce the number of broken keel bones, feather pecking, red mites and foot pad problems. For a small part of the market, dual-purpose breeds are also required and should be tested under differing conditions. Free-range areas, especially in fixed stables for flocks of thousands of animals, have a high nutrient load. Solutions should be developed to reduce this environmental problem and waste of nutrients, while at the same time maintaining the level of welfare that free-range areas provide.

EXPECTED IMPACT

- Improved health and welfare of organic poultry
- Insights into the possibilities and limitations of existing and improved breeds, both for specialised and dual purpose production
- Implementation of new poultry husbandry systems which maintain a high level of animal welfare and health, high environmental standards, and strong economic performance

3.7 DEVELOPMENT OF INNOVATIVE SYSTEMS FOR ORGANIC AQUACULTUR

SPECIFIC CHALLENGE

Organic aquaculture is a growing sector worldwide, which addresses key sustainability issues in seafood production. Organic aquaculture is developing innovative green approaches, based on the appropriate management of processes and resources. It is designed to respect the environment and consumers' health. Although EU rules on organic aquaculture have been in force since 2010, several controversial issues still need to be solved. These are mainly related to environmental performance, the organic production of juvenile fish, fish behaviour and welfare, nutritional needs and feed sources.

SCOPE

Innovative and integrated aquaculture systems need to be developed for use in both freshwater and marine areas, which ensure high overall system performance while reconciling economic efficiency and environmental compatibility. This could be achieved, for instance, by developing polycultures and multitrophic production systems, which are more self-sustaining and have a lower impact on ecosystems. In addition, organic breeding protocols and specific rules need to be developed for the stage in the life-cycle between the hatching and weaning of juveniles. Special attention should be paid to the development of alternative breeding programmes for juvenile shrimps, which do not need eyestalk ablation.

Since fishmeal and fish oil are limited resources, alternative sources of feed ingredients should be identified that satisfy nutritional requirements, maintain animal health and welfare, achieve final products of good quality, and ensure compliance with the organic principles. Finally, an integrated approach is needed to assess fish welfare and optimal stocking density. For organic aquaculture, it is crucial to know the impact of stocking density and other factors (e.g. environmental conditions, water quality, feeding quality) on fish welfare and health.

Projects need a participatory approach with the active involvement of organic farmers and researchers, and the support of the aquaculture industry at local, regional and European levels, as well as consumers.

EXPECTED IMPACT

- Availability of scientific advice for the further economic growth of organic aquaculture
- Development of innovative farming systems for organic aquaculture
- Enhanced environmental performance of organic aquaculture systems
- Reduction of bottlenecks in breeding protocols and juvenile production for organic systems
- Improved protein and lipid sources for organic feed
- Full integration of animal welfare concerns into organic aquaculture systems
- Enhanced quality of organic aquaculture products

3.8 ORGANIC FOOD PROCESSING CONCEPTS AND TECHNOLOGIES

SPECIFIC CHALLENGE

Most of the food we consume, even if organic, is processed. Organic consumers expect processing technologies to secure the high quality of organic food while having a low environmental impact. The Commission's proposal for a new organic regulation (European Commission, 2014a) would also require food processing companies to put in place an environmental management system to improve their environmental performance. However, until now, no specific processing technologies have been developed for organic food products, and there is no clear guidance on how to select the most appropriate technologies. Organic food processors have therefore expressed the need for a Code of Practice on how to implement the rules and principles.

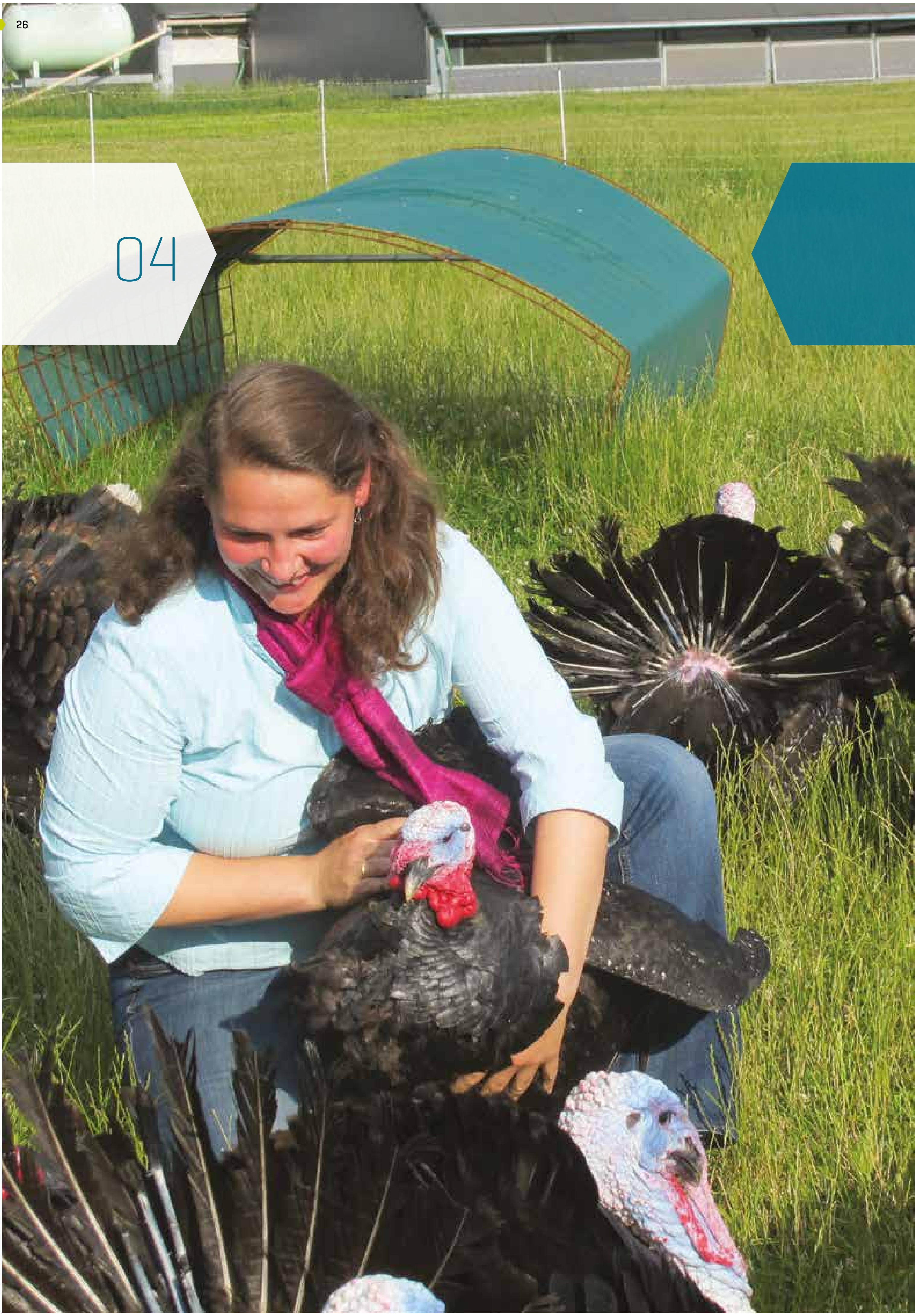
SCOPE

A Code of Practice needs to be developed that provides criteria on which operators can base their choices of the most appropriate technologies for the different steps in organic processing. Existing and new processing techniques should be evaluated along critical control points. A standardised strategy should be developed for the evaluation of processing technologies according to organic principles. The Code should focus on the most relevant product groups, and it should be developed with the participation of the organic industry, consumers and other stakeholders. The Code of Practice would also serve as a support document for the certification process.

EXPECTED IMPACT

- Validated criteria for selecting organic processing technologies
- Identification of technologies that comply with organic principles
- Improved quality of processed organic products
- Increased competitiveness of organic food processing companies
- Increased consumer confidence in the organic sector

04



ORGANIC FARMING AND FOOD SYSTEMS SUPPORT CRUCIAL EMPOWERMENT IN RURAL AREAS

Coordinators:
Susanne Padel
Anna Maria Häring

The empowerment of local economies is an important aspect of European agriculture and food production, involving in particular the primary producers and the consumers. Regionally produced foods with specific qualities increase the diversity of European food in a major way by combining biodiversity, environmental protection and tradition with new alliances and business models. Organic farming practices protect landscapes, biodiversity and the environment. At the same time, high quality foods with a regional identity, produced locally using either traditional or new recipes and processing methods, create jobs and wealth in rural areas, thereby adding to their attractiveness. Organic farmers also provide a range of other goods and services in rural economies, such as agro-tourism, renewable energy and care farming, as well as a diverse range of ecosystems services. This makes organic farming and food production the preferred option for regional development in areas that are not suited to further intensification (e.g. protected landscapes, high nature value and NATURA 2000 areas, environmentally sensitive areas, recreation areas and urban and peri-urban spaces).

The new Action Plan for the Future of Organic Production in the EU (European Commission, 2014b) encourages Member States to utilise the new legal framework for Rural Development to support the development of the organic sector. It also recognises that more effort is needed to maintain and enhance confidence in organic food, and that there are potential opportunities for Europe's farmers and small and medium-sized food producers, while the society gains wider benefits. The following chapter describes three topics for research and innovation related to the empowerment of rural areas, in response to specific challenges:

- Business models and labour dynamics of value addition through food and feed processing
- Strengthening the resilience and innovation capacities of the organic sector
- Agro-ecological and organic farming as means of improving food security and rural development in sub-Saharan Africa and South Asia

In addition, two topics described in Chapter 3 are also related to the empowerment of rural areas:

- Supporting the development of a diverse organic sector through better farming policies, better certification and market data (see p. 18)
- Ensuring consumer confidence in organic food and farming (see p. 20)

4.1 BUSINESS MODELS AND LABOUR DYNAMICS OF VALUE ADDITION THROUGH FOOD AND FEED PROCESSING

SPECIFIC CHALLENGE

The rural economy depends strongly on the possibility of adding value to agricultural products and on the performance of farm-household systems. Especially for small farms, the option of further processing the raw materials they produce is a key factor in their competitiveness. Such regional concepts have been combined successfully with organic production, meeting the growing demand for high quality local food among European consumers, and helping to fulfil the aims of Organic Action Plans. This is particularly true in many of the new Member States, where the number of certified organic processors for feed and food production remains low. A range of business development strategies and cooperative models of food processing and marketing can be useful in strengthening local rural development. It is a challenge for the farmers involved to make the best decisions regarding product concepts, business and cooperation models, labour dynamics, economical structures, technologies, and investments, while still maintaining consumer confidence.

SCOPE

Labour dynamics, farm-household system performance, rural employment and the wellbeing of all those directly involved in organic food processing and marketing should be assessed in different regions of the EU. This would help with the development of an integrated, interdisciplinary body of knowledge about labour in organic food processing and marketing.

Projects would also identify changes in the demand for labour resulting from further business development, including the impact such development has on skills, and would account for the dynamic interactions between different levels (field, farm/household). This includes innovative enterprises such as on-farm processing, and various forms of direct marketing (farm shops, farmers' markets, online sales). The factors responsible for the success or failure of typical value-chain models at different stages of growth should be analysed systematically. This should include analyses of individual business development models, such as specialisation vs. diversification, of the effects on the knowledge and skills required, of investments and the distribution of risk, economies of scale, and added value along the supply chain.

Key success factors for cooperative, farmer-led feed and food processing and marketing initiatives should also be identified, with the findings being fed into new guidelines on business models for such operators. These guidelines should help improve decision making for the development of business strategies or the launch of cooperative businesses at local level.

EXPECTED IMPACT

- Greater success for individual business development in farming, feed and food processing and marketing
- Increased competitiveness of small-scale farm units through the provision of decision-making support for business development
- Starting points identified for measures to improve the attractiveness of work in organic food and farming
- Enhanced rural development through the increased competitiveness of small farms and the development of the organic sector

4.2 STRENGTHENING THE RESILIENCE AND INNOVATION CAPACITIES OF THE ORGANIC SECTOR

SPECIFIC CHALLENGE

In the light of climate change, volatile markets and the complex interdependencies prompted by globalisation, there is a growing understanding that developments can be sudden and unpredictable. Production systems therefore need to be resilient, i.e. they must be able to buffer shocks while also adapting over time, not least to take advantage of new opportunities. However, little is known about what makes farming systems resilient. Agricultural knowledge and information systems may contribute a great deal to supporting the resilience of farms. However, as the organic farming sector evolved from a social movement and has followed very different development trajectories in each Member State, often the innovation systems for organic farming are neither well embedded in national innovation systems nor well connected between the different Member States. Rather, the organic sector has a strong tradition of self-help groups, and of producers, advisors and researchers working together to develop solutions. Little is known about how to foster effective and efficient innovation systems for the specific circumstances of the organic farming and food sector.

SCOPE

A. Improve resilience through diversity of agricultural systems

To understand how to strengthen the resilience of farming systems, it is first necessary to understand better what enables them to cope with uncertainty and surprise – to buffer shocks and respond to emerging challenges in a flexible way. Flexibility in the face of unexpected changes requires knowledge of the interdependencies between the components of the farming system, e.g. the on- and off-farm activities, family dynamics, marketing channels, connections to the regional economy, and interactions within the food value chain. Building on the premise that social, economic and ecological systems are interdependent, research in this area would take into account the impacts of production practices on the agro-ecosystem and on social cohesion.

The research should analyse the impact of specialisation and diversification, at both farm and regional levels, and identify additional approaches to close nutrient cycles in order to stabilise and increase yields. This may also include new collaboration between specialised farms, allowing the closing of nutrient cycles while retaining diversity at the regional level. Research should explore how diversity of farm types, production methods, market types and marketing channels can help address a broad range of societal demands, while at the same time strengthening resilience. Importantly, it should pay special attention to networks and governance systems that enable social learning and experimentation. Indeed, resilience and adaptability depend on information flows, on managing connections and on the active engagement of all relevant stakeholders.

Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries.

B. Strengthening the knowledge and innovation systems for organic farming

Projects should explore the various mechanisms for promoting research and innovation, for demonstration, coordination, networking and training, and for supporting infrastructure. They should analyse the processes for involving farmers in identifying the multiple research and innovation needs, particularly those relevant to small and family-owned businesses.

Success factors for locally adapted innovations provided by nationally and internationally embedded innovation systems should be explored. Finally, robust evaluation criteria are to be developed for innovation initiatives, or for the Operational Groups and other activities of the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI). Projects should focus on the new Member States in particular, and take into account the results of the SOLINSA project, which has identified barriers to the development of Learning and Innovation Networks for Sustainable Agriculture (policy instruments, financial arrangements, research, education and advisory services).

EXPECTED IMPACT

- Better understanding of the types of diversity (at farm and regional level) that allow for complementarities and potential synergies, thus broadening the options for adaptation
- Better understanding of the levers that farms can use to strengthen their resilience
- Characterisation of the governance systems that encourage learning, experimentation and collective action
- Recommendations to policy-makers on how to strengthen resilience at the regional level
- Recommendations to policy-makers on how to boost regional, national and EU-wide innovation systems for organic farming
- Active and effective participation of the organic farming sector in the EIP-AGRI, through improved cooperation between scientists, farmers, farm advisors and industry players, at regional, national and European levels
- Availability of models for organic food and farming innovation systems that will result in effective responses to the big challenges facing agriculture

4.3 AGRO-ECOLOGICAL AND ORGANIC FARMING AS MEANS OF IMPROVING FOOD SECURITY AND RURAL DEVELOPMENT IN SUB-SAHARAN AFRICA AND SOUTH ASIA

SPECIFIC CHALLENGE

While today's global food production is sufficient to cover the nutritional needs of the world's population, food insecurity remains a problem, mainly in rural areas of sub-Saharan Africa and South Asia. There is growing evidence that the adaptation of agro-ecological principles and participation in training on agro-ecological and organic farming methods results in increased productivity, greater stability of yields, and increased crop diversity and soil fertility while using locally available resources. However, the benefits to food security of such approaches is often questioned because of the lower productivity of certain crops under high-input conditions in Europe and the scarcity of robust evidence from other continents.

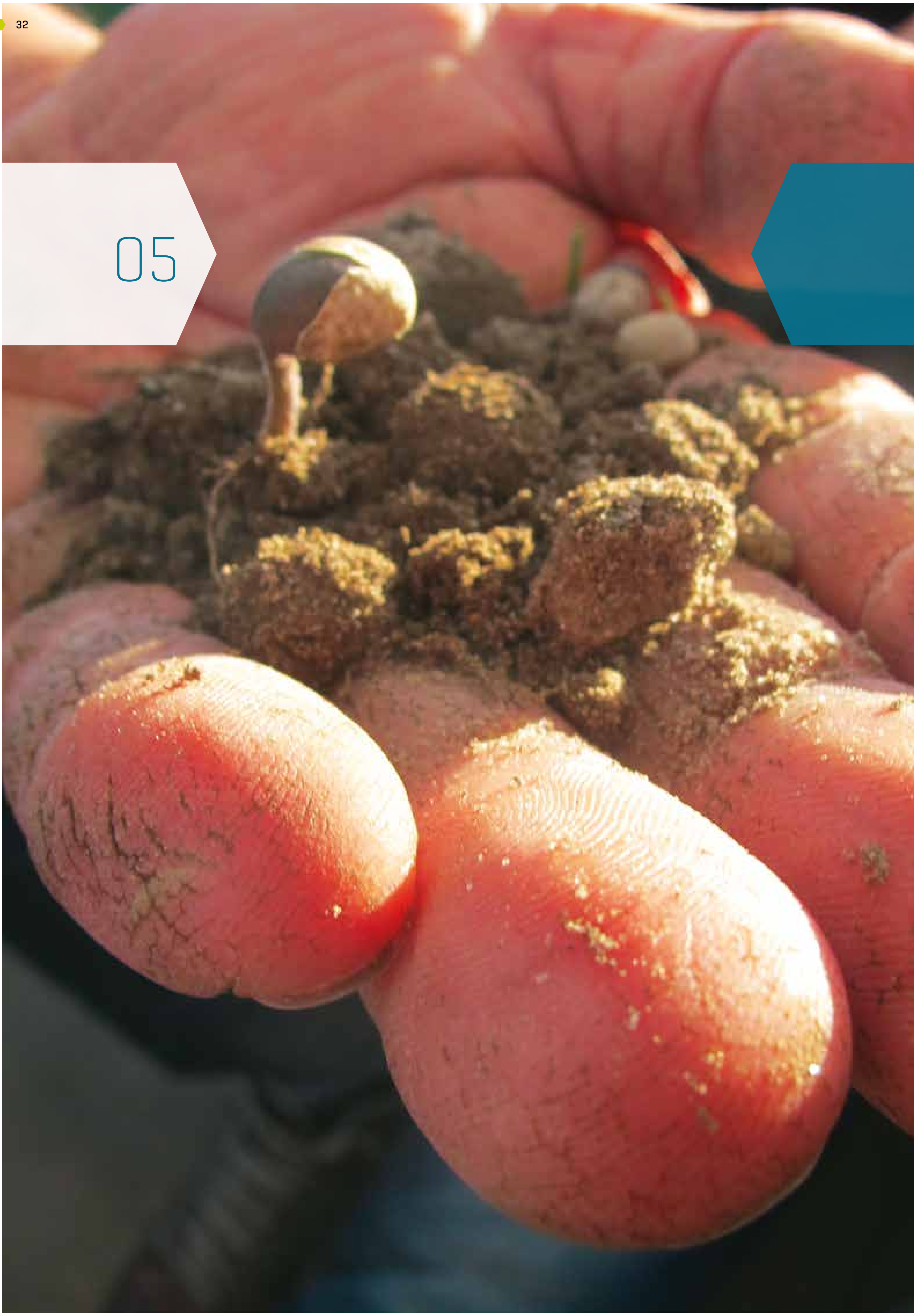
SCOPE

The research should investigate the conditions under which organic farming and agro-ecological approaches and practices contribute to all aspects of food security. It should integrate agronomical, biological, sociological and economic elements in a combination of studies conducted in case areas, and assess the options for generalising and scaling up the results. The research should address the impacts of different food chain development models (with or without links to markets through certification) on food security and rural development at the local and the national levels. Furthermore, the research should investigate the potential benefits and drawbacks of organic agriculture and similar methods in terms of climate change mitigation and adaptation, and their impact on the future availability of water and ecosystem services, including soil fertility and biodiversity.

Projects should pursue a multi-actor approach, involving a balanced partnership of participants from the EU and developing countries (at least three International Cooperation Partner Countries, two of them in sub-Saharan Africa), as well as relevant development organisations and other stakeholders.

EXPECTED IMPACT

- Improved knowledge of the potential and limitations of organic agriculture and agro-ecology as a means of improving food security and market integration
- European consumers can make informed choices about imported organic products
- Exchange of knowledge and good practice in organic agriculture and agro-ecology, with long-term benefits to smallholder farmers


05

ECO-FUNCTIONAL INTENSIFICATION ENHANCES THE PRODUCTIVITY, STABILITY AND RESILIENCE OF AGRO-ECOSYSTEMS

Coordinators:
Chris Koopmans
Cristina Micheloni
Ilse A. Rasmussen

In view of the expected future global demand for food, and considering the environmental and geopolitical challenges faced by Europe, enhancing the productivity, stability and resilience of Europe's agro-ecosystems is a major challenge. Resilience means the capacity of the agro-ecosystem to suffer disturbances but maintain its function. Resilient systems are able to absorb larger disturbances (of climate or input supply, etc.) without any fundamental changes. Organic farmers are continuously trying to increase resilience of their farms by using the natural resources and processes more efficiently.

While organic farmers strive to achieve a high level of overall productivity, based primarily on natural resources and in combination with high environmental standards, there is great potential for further improvements. Higher productivity and yield stability can be achieved through appropriate "eco-functional intensification" – i.e. through the more efficient use of natural resources and processes, improved nutrient recycling, and innovative agro-ecological methods for enhancing the diversity and the health of soils, crops and livestock. Such eco-functional intensification builds on the knowledge of all the stakeholders, and relies on powerful information and decision-making tools in combination with new knowledge and tools in the biological and ecological sciences. Eco-functional intensification is characterised by cooperation and synergies between different components of ecosystems and food systems. It is intended to enhance the productivity and stability of agro-ecosystems, and the health of all components. It will be crucial for the development of organic farming in Europe, and of more sustainable farming systems in general.

Eco-functional intensification as a means of developing organic farming requires a systemic approach that considers processes at the field, farm, landscape and regional levels. In every situation, soils, crops, farmers, landscapes and product chains pose different opportunities and challenges for increasing sustainability (Cuijpers et al., 2013; Erisman et al., 2014, in prep.). While many practices can be adopted by all farmers, organic farming stands for the integration of activities within individual farms and also between different farms, and this calls for collective designs (Titonell, 2013).

Organic farming systems of the future need to be productive and stable (in terms of both yield and quality), but at the same time robust, resilient and environmentally friendly. An adequate supply of nutrients is crucial to such systems. More knowledge is needed to improve the availability and recycling of nutrients from agriculture, industry and society. Improved information systems are vital if all the stakeholders are to have access to the right knowledge. Applied research and the development of experimental and on-farm knowledge are also necessary, in combination with innovative designs, new technologies and integrative theoretical studies.

This chapter describes seven topics for research and innovation related to eco-functional intensification:

- Improved ecological support functions
- Appropriate and robust livestock systems
- Innovative ICT tools for organic cropping systems
- Solutions for resource-efficient primary production, based on the "Internet-of-Things"
- Assessment and sustainability of new technologies for organic agriculture
- Ecological support in specialised and intensive plant production systems
- Breeding robust plant varieties and animal breeds

In addition, five topics described in Chapter 3 are also related to eco-functional intensification:

- Alternatives to contentious inputs used in organic agriculture (see p. 22)
- Availability of organic seeds – towards 100% organic seed (see p. 22)
- Eco-efficient production of animal feed at local level (see p. 23)
- Improving organic poultry systems (see p. 24)
- Development of innovative systems for organic aquaculture (see p. 24)

5.1 IMPROVED ECOLOGICAL SUPPORT FUNCTIONS

SPECIFIC CHALLENGE

Organic cropping systems must be productive, and yields need to be stable in terms of both quantity and quality. At the same time they need to be robust, resilient and environmentally friendly. The concept of eco-functional intensification provides guidance for the design of more resilient agro-ecosystems which use natural resources more efficiently, with improved nutrient cycling, enhanced soil diversity, healthy crops and livestock, and higher economic revenue. However, large-scale adoption is prevented by several factors. The challenge is to combine the concept of eco-functional intensification with demand for large volumes and product uniformity. Large-scale implementation would require activities to be integrated within individual farms and also between different farms in the same area. A more collective design is therefore necessary.

SCOPE

A. Co-design, organisation and cooperation for improved farming systems

Projects should design new farming systems that incorporate all levels, from the field to the region, enhancing the cooperation among different farmers and actors. The new farming systems should improve nutrient cycling by using new crop combinations (intercropping, mixtures with different rooting depths, ecological services providing crops, etc.). They should improve the quality and stability of production at low nutrient levels, and lead to lower production costs. Activities should result in diversified, stress-tolerant, multi-functional and resilient systems (including animal husbandry, energy production and other local production systems) and farming practices with low environmental impact.

Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries. They should follow a multi-actor approach, and are expected to adequately involve the farming sector, as well as regional research and advisory bodies.

B. Recycling nutrients on-farm and with society

Projects should address the dependency of organic farming on conventional production systems for animal manure, and address the challenge of recycling nutrients (e.g. from sewage sludge and green waste) back to agricultural land. There are arguments against the use of non-organic animal manure and urban waste in organic agriculture (e.g. it is unclear what happens to undesirable compounds such as medicine residues). Also, the use of concentrated non-mineral fertilisers is controversial. New systems for recycling nutrients should be designed and promoted among farmers, advisors and public bodies.

Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries. They should follow a multi-actor approach, and are expected to adequately involve the farming sector, as well as regional research and advisory bodies.

C. Farming with biodiversity: integrated approaches at field, farm and ecosystem scale

Farming with (bio)diversity in plant production systems can bring benefits in terms of a higher production efficiency, product quality and yield stability. Greater resilience can be achieved by using local communities of species (local crop varieties and wild species). How can we make best use of the diversity within and between crops, and of the natural biodiversity at field, farm and landscape levels? Farming with (bio)diversity also calls for appropriate organisation of farms, in terms of farm design, cultivation systems and mechanisation.

Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries. They should follow a multi-actor approach, and are expected to adequately involve the farming sector, as well as regional research and advisory bodies.

EXPECTED IMPACT

- Balanced environmental and economic benefits from agricultural production
- Increased competitiveness of organic and agro-ecological farmers through improved yield stability
- Increased awareness among farmers of the need to acquire new knowledge about ecosystem services
- Increased number of sustainable agriculture systems with less dependence on conventional inputs
- Increased demand for bio-waste recycling
- Reduced crop losses due to pests and diseases in organic agriculture
- Increased biodiversity above and below ground, at the field, farm and landscape levels

5.2 APPROPRIATE AND ROBUST LIVESTOCK SYSTEMS

SPECIFIC CHALLENGE

Many organic livestock systems have become increasingly specialised. They have a narrow ecological base, which threatens their resilience. From the initial economic advantage of specialisation, they have become high-risk, low-profit systems. The challenge lies in converting these high-risk systems into sustainable farming systems that rely on smart ecological intensification. A further challenge facing livestock production are the societal expectations regarding animal health and welfare. It is important to reduce and ultimately phase out the use of antibiotics and medication. Finally, economic performance needs to be improved – both per hectare and per labour unit.

SCOPE

A. Forage-based dairy systems – sustainable strategies to increase the health and welfare of dairy livestock

For different agro-ecological and economic conditions, innovative grazing systems are required that improve land productivity, as well as the production of protein and roughage. Grazing systems should aim to maximise roughage intake, while helping to reduce the use of anthelmintics. To reduce both antibiotics and anthelmintics use, effective new practices are required for maintaining udder health, preventing mastitis, preventing hoof problems, preventing and treating parasites, and improving fertility.

In improving the rearing of young stock, the challenges are a) to find innovative methods for keeping dairy calves that allow mother-infant contact without negative productivity effects (with respect to both the labour requirements and milk production), b) to find and apply indicators on top of commonly used production parameters that can be used to assess the welfare and performance of calves and dams under different rearing conditions, and to c) to sustain the long-term benefits of alternatively reared calves.

B. Mixed livestock systems for improved farming and food system resilience

Mixed livestock systems can offer solutions to the negative phenomena that occur at highly specialised livestock farms, such as high nutrient loads and the risk of reduced animal welfare. Research should identify, explore and assess different paths to more robust and resilient livestock systems which include a larger number of species in the same farming system. The integration of livestock in agroforestry should also be considered. This would allow potential ecological synergies to be exploited in all aspects of the farm. Existing mixed livestock systems should be assessed, as well as new concepts in different regions across the EU. This assessment should address production, environmental impact, feeding, management, disease management and animal welfare, and it should use methods such as welfare quality, life-cycle and sustainability assessments. Socio-economic impacts and ecosystem services also need to be considered.

EXPECTED IMPACT

- Increased knowledge and application of dairy systems with improved productivity, reduced environmental impact, enhanced animal health and reduced antibiotic and anthelmintic use
- Increased knowledge and use of more natural calf-rearing systems
- Increased and well-documented knowledge of mixed livestock systems, including mutual benefits for animal health, the environment and socio-economic aspects
- Improved guidelines for managing complex agricultural systems, and for health management in mixed livestock systems

5.3 INNOVATIVE ICT TOOLS FOR ORGANIC CROPPING SYSTEMS

SPECIFIC CHALLENGE

Organic agriculture is labour-intensive, especially since pest and weed controls use physical methods, and few types of machinery are adapted to the small-scale and diverse fields typical of organic agriculture. Modern ICT tools can be used to monitor field operations more easily. They could help increase the quantity and quality of organic crop production, while securing growth opportunities for organic farming.

SCOPE

A. ICT tools and machinery for the management of weeds, diseases and pests

Projects should develop ICT tools for monitoring purposes, as well as various types of machinery for the control of weeds, diseases and pests in ways that are compatible with organic farming. This could be done by developing systems that differentiate between crops and weeds, making automated, selective mechanical weeding possible, by developing new technologies for alternative methods of physical pest control, and by monitoring and forecasting pest and disease outbreaks more effectively. Developing such technologies could encourage the adoption of physical weed and pest control methods in conventional farming too.

Projects should follow a multi-actor approach and should ensure the farming sector, regional research stations and advisory services are adequately involved. Activities should also cover Associated Countries and non-European Mediterranean countries.

B. Selective harvesting and sorting tools for intercropping systems

Intercropping systems can achieve higher production efficiency, product quality and yield stability. However, the lack of machinery adapted to these systems hampers their economic competitiveness. Selective harvesting and sorting tools able to distinguish between the different crops therefore need be developed. Such machinery could also encourage the adoption of intercropping in conventional farming.

Projects should follow a multi-actor approach and should ensure the farming sector, regional research stations and advisory services are all adequately involved. Activities should also cover Associated Countries and non-European Mediterranean countries.

EXPECTED IMPACT

- Increased resource efficiency and productivity in organic farming
- More efficient and feasible non-chemical weed-control techniques, for both organic and conventional farming
- New tools and machinery for physical pest control, for both organic and conventional farming
- Reduced farm production costs due to reduction in manual weeding
- Increased product quality, especially of high value crops, due to the use of selective harvesting and sorting machinery
- Increased knowledge exchange on ICT tools between interdisciplinary research institutions, end users and manufacturers

5.4 SOLUTIONS FOR RESOURCE-EFFICIENT PRIMARY PRODUCTION, BASED ON THE “INTERNET-OF-THINGS”

This topic has been developed in cooperation with the European Technology Platform on Smart Systems Integration (EPoSS).

SPECIFIC CHALLENGE

The agriculture sector is experiencing growing pressure in terms of quality, security, reliability and resource efficiency. Increasingly, ICT is being used to make several industries more resource-efficient, while improving quality monitoring, traceability and consumer awareness. In the agricultural industry, the use of ICT is mostly related to machinery, processing and distribution systems, with limited applications for on-field activities. In order to increase the resource and process efficiency of primary production, there is a need for better monitoring of production (resource use, crop development, animal behaviour), and better understanding of the specific farming conditions (e.g. weather and environmental conditions, and the emergence of pests, weeds and diseases). It would be advantageous to connect data from a multitude of sources, and in different formats, by way of the “Internet-of-Things” (IoT).

The data could be used to develop agronomic models, simulation tools, automated processes and predictive systems to support farmers' decision making. The organic sector could contribute its long-standing expertise with models for farm nutrient management and nitrogen mineralisation.

SCOPE

Projects should develop smart and affordable, open-source solutions running on the "Internet-of-Things", which can:

- Retrieve time- and geo-referenced data from a multitude of sensors in different areas of arable and animal farms. The sensors need to be energy-autonomous and networked, and should be able to operate in sometimes harsh environments
- Form a platform for the integration of field-based data with third-party data such as historical and forecast meteorological data, soil databases, soil, water and air analyses, and databases of weeds, diseases and pests
- Analyse and merge heterogeneous sensor data and feed the processed information into state-of-the-art agronomic and economic models for decision-support systems
- Identify best practices from the collected data and make them available on a platform
- Build on the best practices to design automated processes for monitoring and increasing resource efficiency, and for developing simulation tools which allow the decision-support systems to function predictively
- Apply and foster advances in autonomous driving for plant monitoring and harvesting
- Support data exchanges with existing platforms (public or commercial), stimulate knowledge exchange and interaction between farmers, advisors and researchers, and maximise adoption of solutions and best practices
- Provide data from primary production as tracking for farm-to-fork records.

Projects should be sensitive to potential ethical or regulatory issues, notably those related to autonomous processes, and should pay attention to governance issues like the ownership of data, and privacy and liability concerns. They should provide business models for the exploitation of the IoT-based solutions.

EXPECTED IMPACT

- Availability of IoT-based tools for increased resource efficiency in primary production
- Translation of complex data from agronomic models into simple and action-oriented information for farmers
- Widespread development and diffusion of predictive decision-support systems in agriculture, with particular emphasis on nutrient management models
- Reduction of barriers to the use of decision-support systems and IoT-based solutions
- Development of third-party applications based on collected data
- Reduced time-to-market of innovative IoT-based solutions in the agricultural sector
- More resource-efficient agricultural production; improved quality and stability of yields
- Reduced nutrient discharges from agricultural fields

5.5 ASSESSMENT AND SUSTAINABILITY OF NEW TECHNOLOGIES FOR ORGANIC AGRICULTURE

SPECIFIC CHALLENGE

Several new technologies claim to make agriculture more sustainable, above all advancements in the area of genetic improvement, nanomaterials and bio-based materials. Before advocating their use in organic farming, a robust evaluation of these technologies is needed, considering the legal framework of organic food production. Among the stated objectives of organic production are the commitments to respect nature's systems and cycles; to sustain and enhance the health of soil, water, plants and animals; and the protection of biodiversity, responsible use of energy and natural resources, respect for animal welfare, and the production of high quality food. An assessment based on evidence is needed to identify the new technologies that can contribute to the development of the organic sector and the eco-functional intensification of Europe's food and farming systems, while at the same time adhering to the organic principles of systems management, and restricting the use of external inputs, and to the IFOAM organic Principle of Care which challenges the use of technologies that contradict these principles.

SCOPE

On a conceptual level, there is a need to understand the nature of any new technology, and to compare it rationally, ethically and scientifically against accepted principles of organic production. On a practical level, it is necessary to assess scientifically the interactions and impacts that new technologies might have on farms, animal and human health, product quality, broader ecosystems and society.

- **Genetic improvement** – Technologies, such as marker-assisted breeding (MAB) and other new techniques (currently in use or under investigation) to introduce new or improve existing traits in seeds and other planting stock, animal breeds or other inputs, such as microbial preparations, should be evaluated for their compliance with the organic principles.

- **Nanomaterials** – The range of applications for nanotechnology is broad. It includes material additives, all kinds of production and processing materials and ingredients, packaging, and delivery systems. However, their long-term effects are as yet unknown, and their use in organic systems should be evaluated.

- **Bio-based materials** – In agriculture bio-based materials can be used in the field (e.g. bio-plastic as mulch), as packaging materials, or for other applications. Their sustainability impact and compliance with organic principles need to be assessed. Similarly, the use of biofuels to produce energy warrants an assessment of its potential impact on organic production and system health, on the environment (especially through climate change), and on food security, but also to gauge the potential for innovative biofuel production using organic methods. Other applications for bio-based materials may also be considered.

EXPECTED IMPACT

- Assessment of specified new technologies, their products and scope of use, and their impacts on agricultural systems and their respective value chains
- Coordination of research and field studies for selected technologies and products, with corresponding evaluation and dissemination of results
- Replicable investigative methodologies, criteria and models for evaluating new technologies, which can be used by actors in other environments and/or scenarios
- Coordination of the development of innovations using specified technologies in ways that are compatible with organic principles

5.6 ECOLOGICAL SUPPORT IN SPECIALISED AND INTENSIVE PLANT PRODUCTION SYSTEMS

SPECIFIC CHALLENGE

Fruit tree orchards, vineyards and greenhouses are highly specialised, and therefore simplified, cropping systems. Their management requires the intensive use of energy, water and other inputs, and the use of functional biodiversity is still limited. The challenge is to find practical ways to develop more resilient agro-ecosystems for perennial and protected crops. There is a need for great efficiency in using natural resources, as well as high environmental standards and economic performance. New sustainable, climate-neutral greenhouse systems must be designed, with sound soil, nutrient and water management, and biological pest and disease controls based on ecological approaches.

SCOPE

A. Concepts for sustainable, resource-efficient and resilient fruit and viticulture production

Organic orchards and vineyards still depend on inputs for pest and disease control, as well as for fertilisation, and the agro-environmental services they produce are limited. On the other hand, fruit and wine production are important sectors of the European organic market. Consumers expect high standards of environmental sustainability, as well as good-tasting and nutritious products. Projects should combine knowledge of soil science, agroecology, entomology, plant pathology, weed science, economics, etc. in order to design innovative, productive systems that meet these requirements. They should include further development, testing and on-farm validation of the innovative systems in different important fruit and wine growing regions of Europe. The projects should follow a multi-actor approach with an active involvement of all stakeholders (growers, researchers, advisory services, manufacturers, consumers and citizens). Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries.

B. Concepts for sustainable organic greenhouse systems

The market demand for out-of-season organic vegetables is, to a large extent, fulfilled by production in glasshouses, plastic-covered greenhouses or poly-tunnels. However, more research is needed to increase the ecological and economical sustainability of these systems. Problems which commonly arise all around Europe include poor productivity, the need for adequate supplies of water or of nutrients under the provisions of the Nitrates Directive, and the use of broad spectrum plant protection products and copper-based fungicides, which hamper natural crop protection. In north-western and central Europe, heating with fossil fuels also needs to be addressed. A general constraint on all greenhouse systems is the difficulty of practising crop rotation. Projects should devise new concepts of climate-neutral and sustainable, yet economically sound and resilient greenhouse and poly-tunnel systems for various climatic conditions, and suited to different farming systems (including urban farming). Technological and agro-ecological solutions should be developed to reduce the use of inputs that have a high environmental impact (e.g. plant protection products, peat substrates, fossil fuels) and to prevent nutrient losses.

Activities should cover different geographical and climatic conditions, and include Associated Countries and non-European Mediterranean countries.

EXPECTED IMPACT

- Improved competitiveness of organic fruit, grape/wine and greenhouse production
- Models for resilient and sustainable organic fruit and grape production systems
- Concepts for sustainable and climate-neutral organic greenhouse production systems suitable for different climates, conditions and agro-ecosystems
- Closed nutrient cycles and improved efficiency in the use of water and inputs

5.7 BREEDING ROBUST PLANT VARIETIES AND ANIMAL BREEDS

SPECIFIC CHALLENGE

Agriculture faces major challenges, such as the decreasing availability of land and water, poor soil fertility and reduced access to inputs (e.g. fertilisers), climate change and biodiversity loss. The most important driver of biodiversity loss is the international consolidation in the seed and breed industries. This focuses production on just a few plant varieties and animal breeds, cultivated under optimal and controlled conditions.

There is a need to reduce the dependency on abundant supplies of resources such as soil, water, nutrients and fossil energy, and instead to develop livestock and plants that are adapted to low-input conditions. Until now, research has aimed to optimise nutrition to meet crop and animal demands. Greater focus is needed on developing the most suitable livestock and crop cultivars for low-input conditions, while considering whole crop rotation and animal husbandry processes at farm level.

SCOPE

Breeding to enhance the robustness or resilience of crops and livestock, enabling them to withstand unfavourable conditions, is a very complex process and poorly understood. The physiology and genetics that underlie the emergence of traits adapted to low-input conditions and low nutrient uptake are complex; they differ for different crop types and animal species and they depend on environmental conditions.

Little is known about the role played by below-ground plant traits and their contribution to uptake efficiency, or about what traits drive the efficient use of nutrients. Some research has been carried out on arable crops, such as cereals, maize, oilseed rape and potatoes (e.g. FP7 project NUE-CROPS), but little is known about how to adapt vegetables to low-input conditions.

Plant breeding has focused mainly on developing plants for monocultures, although mean yields in (inter- or intra-specific) mixed cropping systems are generally higher than for components grown separately. There is evidence that mixed cropping or intercropping can contribute to the efficient use of above- and below-ground resources, but little or no attempt has been made to breed for optimal combinability of genotypes in diverse cropping systems. Projects should address one of the following areas.

A. Breeding for improved nutrient efficiency in vegetables adapted to low-input cropping systems

Vegetable crops often require more inputs of nutrients and water than arable crops, but the demand also differs between short- and long-cycle species, or between different stages of maturity within a crop species. Some crops are complicated since the younger leaves that normally conduct photosynthetic activity are hidden in a head, as with cabbage types. To what extent can the improvement of below-ground traits (e.g. root systems, interaction with mycorrhizas) contribute to greater efficiency of nutrient and water use? What tools (e.g. crop growth models, molecular markers, and indirect traits) can support breeders in developing efficient breeding strategies?

B. Breeding for diverse and low-input arable systems

The underlying basis of increased yield potential and yield stability in diverse, arable mixed cropping systems is poorly understood. The beneficial effects include above- and below-ground interactions between individuals, as well as enhanced community resistance to abiotic and biotic stresses. To optimise these interactions, plant genotypes with contrasting – and complementary – traits need to be identified and brought together in combinations appropriate to the environmental conditions. It is necessary to improve the combinability of genotypes in diverse interspecies mixtures under low-input growing conditions. Plant-to-plant interactions involving plants of different species in a mixed or intercropping system, or between plants of different varieties within the same species, is different from plant-to-plant competition between individual plants of the same genotype, as occurs in monocultures. Cropping patterns need to be fine-tuned to accommodate genotypic effects on vegetation periods, on nutrient acquisition, and on the microbial communities mediated by root exudates. For an efficient breeding strategy it is important to know what traits play key roles in adaptation to diverse cropping systems, and how that differs according to the cropping systems and species involved.

C. Breeding for diverse and low-input animal husbandry

It is generally agreed that animals in low-input systems should be robust, healthy and efficient. In addition to these market values, non-market values need to be considered, such as the ethical values of improved animal welfare, the conservation of genetic resources (native breeds), and the reduction in environmental impacts by reducing the consumption of concentrate feeds or greenhouse gas emissions (e.g. methane). However, selection criteria for the necessary functional traits are largely missing. The FP7 project, LowInputBreeds, has identified genomic breeding goals for functional traits for dairy cows, and positively evaluated selection options for heat and parasite resistance in sheep and pigs. Several other ongoing projects are working to identify new phenotypes, including behaviour traits, for efficient and healthy animals, in particular ruminants on grass-based diets. All these approaches have been developed for specific populations, so their value would have to be validated in different breeds and under different management and climatic conditions. In particular, attention should be paid to small populations of native breeds of different species, all over the world. They are usually well adapted and efficient under local conditions, but not so strictly selected. To save local breeds and biodiversity, these breeds have to be improved by selection without losing their genetic variability.

EXPECTED IMPACT

- Pre-breeding material of vegetable crops adjusted to low external input conditions
- Improved understanding of how below-ground traits and plant-microbe interactions affect resource-use efficiency
- Understanding of physiology and the genetic basis underlying plant-to-plant interactions
- Identification of complementary traits for improved productivity and yield stability of crop mixtures
- New varieties with optimal combinability allowing implementation of diverse mixed cropping systems
- Improvement in the health, robustness and longevity traits of commercial animal breeds
- Performance and genomic testing methods available for all main livestock species
- Increased knowledge about the relationships between robustness, health and adaptability traits on the one hand, and animal behaviour and welfare on the other
- Increased understanding of market and non-market values for the improvement of commercial, low-input and local animal breeds
- Characterisation and performance-testing of native breeds of different species in different regions of the world
- Development of breeding schemes for small populations of native breeds

06

HIGH QUALITY FOODS ARE THE BASIS FOR HEALTHY DIETS, WELLBEING AND QUALITY OF LIFE

Coordinators:
Johannes Kahl
Alexander Beck

For most consumers, expectations of high quality and a positive effect on the environment and health are important drivers for buying organic food. The positive environmental effects of organic farming have today been scientifically demonstrated, but scientific evidence about the (public) health effects of organic food production and consumption is still scarce. Nevertheless, organic food systems can be expected to enhance public health, because most stages in organic food production are regulated for a lower impact on the environment and limited use of chemicals like additives and processing aids.

The integrity of organic food and the organic food chain is one of the major concerns of the organic movement and organic consumers. This is especially important in view of the rapidly growing market worldwide. Concepts and methods are needed for assessing the integrity and the systemic approach of organic food chains. To close the gap between the organic principles and their practical application, an organic food quality model has been developed, which includes food attributes as well as parameters for the food production process (Kahl et al., 2012; Kahl et al., 2014). According to this model, only a few standards for "organic quality" have been established so far. Thus, there is tension between the widely cited principle of systems approach to organic production, and the lack of clear criteria and tools, including testing methods, for evaluating this systems approach. Organic food quality is primarily process-oriented, but for an evaluation it is essential to connect process-based and product-based indicators. Such an evaluation could test, on the one hand, the extent to which organic processing criteria have indeed been implemented, and on the other, the extent to which the foods contribute to health.

In a growing market for processed food, organic processors, who are obliged to "process with care" (Article 6d, Council Regulation EC/834/2007), are in need of more "gentle" techniques and natural substances that "guarantee that the organic integrity and vital qualities of the product are maintained through all stages of the production chain" (Recital 19, Council Regulation EC/834/2007). Organic food processors have therefore expressed the need for a Code of Practice that would provide criteria for operators to select the most appropriate technologies for the different steps in organic processing.

This chapter describes three topics related to the integrity of organic food and the impacts of organic food on health and wellbeing:

- The contribution of the organic food system to sustainable diets
- Public health effects of organic food systems in Europe
- The effects of organic foods and foods of different quality on the risk and severity of allergies, and on the general health and well-being of children

In addition, two topics described in Chapter 3 are also related to theme of food for health and wellbeing:

- Ensuring consumer confidence in organic food and farming (see p. 20)
- Organic food processing concepts and technologies (see p. 25)

6.1 THE CONTRIBUTION OF THE ORGANIC FOOD SYSTEM TO SUSTAINABLE DIETS

SPECIFIC CHALLENGE

People should be enabled and empowered to make healthier choices, regardless of their living conditions, and to minimise the risks and impacts of illness.
The Europe 2020 strategy aims to turn the EU into a smart, sustainable and inclusive economy, promoting economic growth for all. One prerequisite of this is to keep the population in good health; among other things, sustainable diets are important for this. The organic food system shows great potential to support sustainable diets in Europe. Yet little is known of the essential factors affecting this issue.

SCOPE

Being legally defined, the organic food system is one of the best documented and increasingly well-researched food systems. Most studies on sustainable diets and related concepts – such as nutrition ecology, sustainable nutrition, sustainable food systems and sustainable consumption and production (SCP) – include, either explicitly or implicitly, organic food systems. Consequently, organic food systems could contribute significantly to the study and definition of indicators for sustainable diets. Research is needed to examine how, and how much, organic systems contribute to sustainable diets, both in theory and in practice. Once indicators have been identified, research into organic practice can detect constraints and barriers. Based on this, metrics can be defined for several cultural-geographical areas and their diets, to measure nutrition and health, and aspects related to the environment, the economy, society and culture.

EXPECTED IMPACT

- Information on the extent to which the organic food system does or does not contribute to sustainable food systems.
- Metrics for assessing sustainable diets
- Policy recommendations for promoting sustainable diets

6.2 PUBLIC HEALTH EFFECTS OF ORGANIC FOOD SYSTEMS IN EUROPE

SPECIFIC CHALLENGE

Evidence suggests there are significant links between agricultural methods, food quality and public health. Promoting health at various levels, from the individual to communities, is therefore considered a central principle of organic agriculture. Organic agriculture aims to produce high quality, nutritious food that contributes to preventive health care and wellbeing. In some cases, organic farming is integrated with education and therapy objectives. Strategic investment in organic farming would therefore have a major impact on public health. However, to date extremely little research has taken place looking at the relationship between public health and organic food production and consumption.

SCOPE

The relationship between public health and organic food production and consumption needs to be examined by a comprehensive review of the current state of knowledge. The relationship should be investigated in different settings (education, workplaces, hospitals, tourism and other leisure settings). Health impacts on people working in the organic food chain should be investigated, including their exposure to agricultural inputs and products used in food processing. The relationship between lifestyle choices and "organic diets" also needs to be researched. In this respect, the role of social and organic community networks should be considered.

A number of organic farms provide opportunities for so-called care farming, which plays a role in the rehabilitation and social reintegration of people with a wide range of medical and/or social needs. The contribution of the organic sector to this area needs to be analysed. The social, clinical and economic performance of care farming should be assessed with respect to different policy support systems. Successful systems of care farming need to be identified, and knowledge transfer between European countries and between different target groups should be promoted.

EXPECTED IMPACT

Availability of data and evidence to support smart investments in organic agriculture, to promote public health in a more integrated and systemic way.

6.3 THE EFFECTS OF ORGANIC FOODS AND FOODS OF DIFFERENT QUALITY ON THE RISK AND SEVERITY OF ALLERGIES, AND ON THE GENERAL HEALTH AND WELL-BEING OF CHILDREN

SPECIFIC CHALLENGE

Allergies affect many people, and the number is rising. Western countries are particularly affected. Even now, it is still not clear why people get allergies, but environmental factors and/or imbalances in food intake during the first years of life are thought to be involved.

Non-organic foods might contain traces of pesticide combinations which, even if they are below detection limits or they meet permitted levels for single pesticides, might still have harmful effects on health. Limited but promising studies have recently been completed on the positive effects of organic diets on health and the reduction of allergies. Whether these results are caused by the absence of synthetic pesticides or by specific nutrients in the organic food is not known.

It is therefore important to carry out an experimental human intervention study with food products of a well-documented quality, while controlling a wide range of health-related factors. To perform such an intervention study, it will be necessary first to define relevant end points – so-called biomarkers.

SCOPE

A long-term intervention study with children is needed to measure the effect of organic food and food of other qualities on general health and well-being, including the risk and severity of allergies. Biomarkers and techniques from medical, natural and social sciences should be used. The indicators should be based on a dynamic health model which takes account of resilience, balance, self-regulation and robustness. The project should consider not only farming conditions, but also food processing conditions as these affect the content of compounds that might be involved in immunological reactions.

EXPECTED IMPACT

The increasing incidence of allergies is expensive, both for the consumers affected and for society. If the intake of organic food is shown to reduce the risk and severity of allergies, this would have an enormous impact on consumers, as well as on producers and industry.

07

PRIORITIES FOR THE EUROPEAN INNOVATION PARTNERSHIP FOR AGRICULTURAL PRODUCTIVITY AND SUSTAINABILITY

Launched in 2012, the European Innovation Partnership for Agricultural Productivity and Sustainability, otherwise known as EIP-AGRI, is a new policy instrument for more stakeholder- and demand-driven research and innovation in agriculture. It encourages those involved in different segments of the agri-food system (farmers, businesses, researchers and advisors) to share their ideas and experiences. Working together, they are expected to devise innovative responses to problems and to develop academic findings into practical applications, thereby "delivering solutions that are well adapted to circumstances and which are easier to implement" (European Commission, 2014c). The EIP-AGRI tries to marry productivity and sustainability, contributing to a "steady supply of food, feed and biomaterials, developing its work in harmony with the essential natural resources on which farming depends" (EIP-AGRI, 2014).

The EIP-AGRI is implemented through Horizon 2020, as well as national or regional Rural Development Programmes. Horizon 2020 projects contributing to the EIP-AGRI are called multi-actor projects. They should address the needs and problems of farmers and other practitioners. They should also involve the relevant stakeholders, forming a consortium of actors that offer complementary knowledge (scientific, practical, etc.). All the topics described in the previous chapters require such a multi-actor approach involving a balanced partnership of participants.

Under the Rural Development Regulation, the main instrument for applying the EIP-AGRI are the Operational Groups. These build bridges between researchers, farmers, rural communities, businesses, NGOs and advisory services. They are expected to tackle practical problems and not act merely as discussion groups. This EU-wide Strategic Research and Innovation Agenda cannot define the priorities of the Operational Groups because, by their very definition, the groups are there to tackle specific local or regional needs.

Finally, there are the Focus Groups. These are temporary groups, usually consisting of 20 researchers and practitioners, which explore innovative practices and identify research needs in specific areas. Each group should draw on the experiences gained in useful, related projects. In brief, an EIP-AGRI Focus Group has the following objectives:

- Take stock of current practices in its specific area, and list problems and opportunities
- Take stock of current research in that area, summarising possible solutions to the problems identified
- Identify needs based on current practice, and provide guidelines for further research
- Highlight priority areas for innovative action, suggesting topics for the Operational Groups to work on, as well as new project formats for testing and disseminating innovative approaches

Focus Groups can have a big impact in terms of setting the agenda for the EIP-AGRI. This chapter lists 10 priority areas for Focus Groups:

- Pest and disease control in organic and low-input perennial systems
- Crop rotations
- Vegetable breeding
- Agroforestry
- Machinery for non-chemical weed management
- Improving health and welfare for sows
- Valorising public goods and services provided by agriculture
- Sustainable, diverse and healthy diets
- Reducing food loss and food waste in Europe
- New solutions for managing farm succession and providing access to land for new entrants

7.1 PEST AND DISEASE CONTROL IN ORGANIC AND LOW-INPUT PERENNIAL SYSTEMS

Fruit trees and vines frequently get attacked by pests and diseases. Besides their environmental infrastructure, organic systems depend a great deal on the few essential plant protection agents that are actually allowed. The reduction of this dependency would be a very important step towards their long-term sustainability. Several novel production systems are currently being evaluated in national and international projects (e.g. CO-FREE). Based on these new insights and the results of earlier experiments, this Focus Group should propose advanced strategies for pest and disease control in organic and low-input fruit tree and vine systems. The performance of natural enemies should be improved. New farming practices and biodiversity management should reinforce the self-defence capacity of plants. In addition, new more robust varieties should be developed and tested. The Focus Group will help increase the productivity of organic fruit trees and vines, and reduce food losses.

7.2 CROP ROTATIONS

Rotating crops is an essential part of agroecological production systems. In particular with the inclusion of legumes, it improves the fertility of the soil. It also increases the soil organic matter content (carbon sequestration) and thus contributes to climate change mitigation. Furthermore, it reduces the risk of pest and disease outbreaks, and increases the resilience and economic stability of the farm. But what crop rotations work best? Which crops should be combined, how (intercropping, mixed cropping, cover cropping, green manures) and in which soil types? How can knowledge about crop rotations best be disseminated? How would it be possible to improve the competitiveness of crop rotations that include crops which do not provide a financial return? The Focus Group should provide answers to these questions.

7.3 VEGETABLE BREEDING

Vegetable growing is an important component of EU agricultural production. Fresh vegetable consumption is clearly acknowledged to be an essential element of a healthy diet. European vegetable production has a long tradition (especially in the Mediterranean area) but it currently faces strong competition from North Africa, the Middle East and South America, where climatic conditions and labour costs keep mass production cheap. Nevertheless, vegetable production in the EU has great potential if it is oriented towards quality and authenticity, and uses low-input sustainable production systems. To achieve this, a review of the current breeding paths is needed, with a resetting of goals to achieve greater diversity of crops and varieties capable of adapting to different and evolving climatic conditions (including the enlargement of original cultivation areas), to new handling and processing techniques, and to changing consumers expectations. In some regions of Europe, there is still a large diversity of vegetable genetic resources available. These need to be preserved in order to facilitate the new breeding paths. Practical experiences of projects in participatory breeding, but also traditional knowledge must be taken into account

7.4 AGROFORESTRY

Agroforestry is the practice of deliberately combining woody vegetation (trees or shrubs) with crops and/or animal systems to benefit from the resulting ecological and economic interactions. EU research projects (e.g. AGFORWARD) have been working to develop a better understanding of agroforestry systems. This Focus Group should bring together practitioners, researchers and other stakeholders to evaluate the latest knowledge of agroforestry systems in Europe and assess their potential. It should compare different types of agroforestry practices (silvopasture, silvoarable, windbreaks…) with their corresponding treeless systems, highlighting the main advantages and disadvantages. It should also identify methods by which economically viable farms implement agroforestry, determine how crop and pasture yields are influenced by the presence of trees at different latitudes, and consider how to optimise yields in agroforestry systems. Furthermore, the Focus Group should list adverse factors that limit the use of the techniques and systems described and identify the main regulations that prevent implementation of agroforestry systems. It should suggest ways of addressing these limiting factors and identify any remaining research and innovation needs.

7.5 MACHINERY FOR NON-CHEMICAL WEED MANAGEMENT

Weeds are one of the biggest problems affecting quantity and quality of yields worldwide. While conventional agriculture generally relies on the use of pesticides, herbicide resistance is becoming more widespread. Organic and low-input agriculture use crop rotation and other measures, including the use of ecosystem services, for the management of weeds. However, there are also significant applications of mechanical and other non-chemical weed control methods. Precision agriculture is not (yet) widespread in organic agriculture, but advanced technologies such as robotic intra-row weeders, precision seeding technology and camera-guided inter-row cultivators are becoming increasingly well-known and more commonly used in both organic and conventional agriculture. Based on new insights and results from earlier projects such as WEEDS, this Focus Group should propose advanced strategies for the introduction of machinery for non-chemical weed management in organic, low-input and conventional agricultural systems.

7.6 IMPROVING HEALTH AND WELFARE FOR SOWS

The farming of pigs is associated with numerous animal welfare problems, one of which concerns the confinement of sows during and after pregnancy. Sows are commonly kept in narrow farrowing crates, from a week before farrowing until the piglets are weaned. This is intended to prevent piglet mortality due to crushing. The confinement methods are bad for the welfare of the sows, which should be provided with enough space and nest-building materials to practise their natural behaviour. Alternative keeping practices that provide greater freedom of movement would lead to improved sow health, while also supporting the aim of minimising piglet mortality. They could also have other quality and productivity advantages. When alternative farrowing systems are combined with the use of breeds with good maternal properties, a farrowing crate is not necessary to protect the piglets.

Research on alternative free farrowing systems has been carried out in the UK, Sweden, the Netherlands and Switzerland. Some of these alternatives achieve piglet mortality rates as low as those experienced in farrowing crates, and thus help to achieve animal health and welfare objectives for the sows and piglets alike. Additional research may also be underway in Germany and Denmark. This Focus Group should examine which of the alternatives, including breeding options, are most suitable in terms of practicality and cost, and it should recommend ways of encouraging increased uptake of these alternatives among pig farmers.

7.7 VALORISING PUBLIC GOODS AND SERVICES PROVIDED BY AGRICULTURE

Agriculture not only produces food and commodities, but also many public goods and services (e.g. water buffering, water purification, carbon sequestration, biodiversity conservation). However, the delivery of these services is often insufficient. The Strategic Implementation Plan of the EIP-AGRI recognises this when it states that: "The EIP is called upon to deliver innovative solutions to safeguard the delivery of public goods [...]." This Focus Group should propose economic incentives for the delivery of public goods and services. A variety of new partnerships, both public and private, should be developed for delivering – and rewarding – public goods and services.

7.8 SUSTAINABLE, DIVERSE AND HEALTHY DIETS

Diets and eating habits are an essential part of sustainable food systems. This Focus Group should look at forms of social innovation to increase the consumption of, and improve access to fresh, regional, seasonal and organic food. It is important to promote diets with a greater proportion of plant-based products as this would considerably reduce the ecological footprint of Europe's food system, while at the same time increasing public health. The Focus Group should look in particular at the role of public procurement policies and education. Special attention needs to be paid to vulnerable groups like children, people living in poverty and social exclusion, rural communities or minorities.

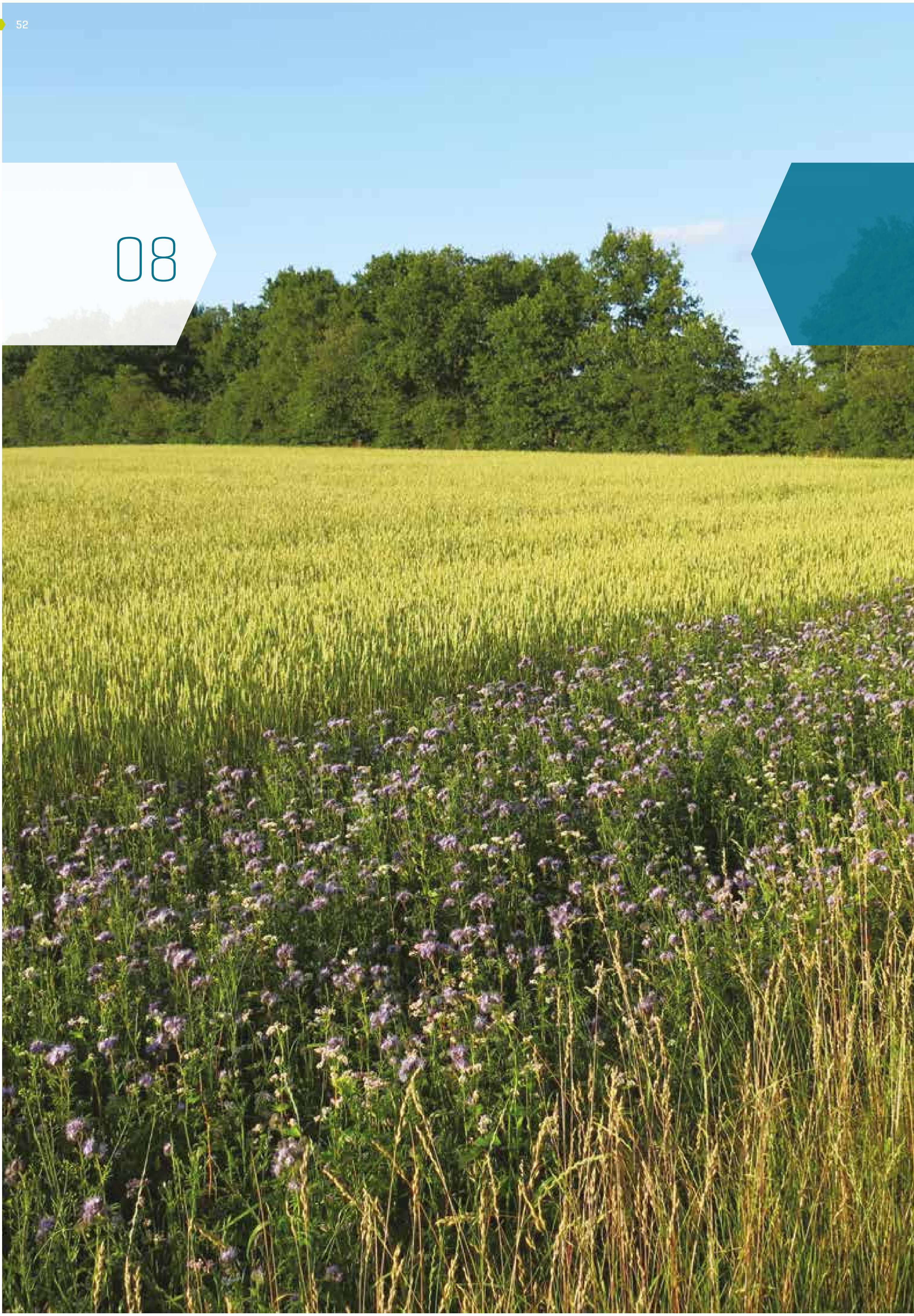
7.9 REDUCING FOOD LOSS AND FOOD WASTE IN EUROPE

Lost and wasted food accounts for about 30% of global agricultural production. Reducing this food wastage is an essential strategy for increasing sustainability in the global food system, as it would reduce the pressure to increase yields or to expand cropping areas to feed the growing global population. Food wastage occurs for different commodities and at different levels of the value chain, in different world regions. In Europe it mainly arises at the final consumer level. On the one hand, the Focus Group should look at how the storability of food can be increased sustainably. This refers to technical measures, but it may also be possible to suggest changes in choice of varieties for certain crops. On the other hand, the Focus Group should address behavioural change to reduce food waste at the consumer level. The consumers of organic food might prove particularly open to this and could serve as a test case.

7.10 NEW SOLUTIONS FOR MANAGING FARM SUCCESSION AND PROVIDING ACCESS TO LAND FOR NEW ENTRANTS

The significant aging of the farming population is a key challenge to the sustainability of Europe's agricultural sector. The reformed Common Agricultural Policy (CAP) has introduced a mandatory direct payment top-up for young farmers. Pillar 2 also provides a measure for farm and business development to facilitate the establishment of young and new farmers. Agricultural education, and training in food production have once again become popular choices among young people. Despite these positive trends, a blind-spot remains in the problems of access to land. More collaborative or multi-stakeholder initiatives and win-win solutions are needed to overcome the barriers to generational renewal. The aim of this Focus Group will be to identify best practices for the support of young and new farmers, as well as practices that reduce the risks of financial loss and debts, facilitate access to land, credit and other funds, or promote new routes into farming and marketing activities (diversification, progressive start-up, Community Supported Agriculture...). The Focus Group will also propose ways in which (existing) initiatives can learn from each other. To improve their results and their impacts, such initiatives should be better connected, both across borders and with the mainstream actors.

08



NEXT STEPS

Under the three main themes – empowerment of rural areas, eco-functional intensification and food for health and wellbeing – this Strategic Research and Innovation Agenda describes 13 research and innovation questions. TP Organics is convinced that work in these areas will support the sustainable growth of the organic sector in Europe and beyond, while also leveraging the organic sector's contribution to sustainable food security, and fostering entrepreneurship and economic opportunities in rural areas. Eight further topics dealing with the specific needs of the organic sector are discussed in a separate chapter. The distinction is necessary as the organic sector operates in a specific market and has to comply with specific EU regulations. Another chapter lists 10 priorities for activities of Focus Groups, which could have a big impact on the agenda setting of the EIP-AGRI.

Despite the potential of the organic sector to contribute to innovative and sustainable approaches in the agricultural sector as a whole, research investment in organic farming is lagging behind. Globally, USD 49 billion is spent each year on food and farming research (Beintema et al., 2012). The spending on research for organic food and farming is probably less than 1% of this amount (Niggli et al., 2008; Tittonell, 2013). In the EU's 7th Framework Programme for research (2007-2013), the budget for organic research amounted to a mere 2.3% of the total EUR 1.66 billion allocated to agriculture. TP Organics now calls, therefore, for a more ambitious level of investment in research for organic food and farming. At least 10% of the Horizon 2020 budget for "Food security, sustainable agriculture and forestry, marine and maritime and inland water research, and the bio-economy" (Societal Challenge 2) should be dedicated to organic food and farming. This percentage reflects the share of agricultural land under organic management in the EU. Currently, 5.6% of agricultural land in the EU is organic (Meredith and Willer, 2014), but the potential is estimated at 15-20%.

The EU Organic Action Plan (European Commission, 2014b) recognised the importance of research and innovation for the development of the organic sector. However, it lacks clear commitments. The Horizon 2020 Work Programme 2016/2017 will be the first opportunity for EU policy-makers to show ambition in promoting research and innovation for organic food and farming. Taking the Strategic Research and Innovation Agenda as a basis, TP Organics will provide input to the drafting of the 2016/2017 and future Work Programmes. It will also seek cooperation with other European Technology Platforms (ETPs) in order to jointly promote those topics that are of common interest.

However, the support through Horizon 2020 will not be sufficient to meet all the research and innovation needs described in this document. Complementary support from Member States will also be necessary. Supported by top-up funding from the European Commission, ERA-Nets and Joint Programming Initiatives (JPIs) are the main instruments for coordinating national (regional) research activities. TP Organics will work to promote the Strategic Research and Innovation Agenda among the relevant ERA-Nets and JPIs. The ERA-Net CORE Organic has been very successful in bringing the smaller players of the organic research community together, in order to conduct better research more efficiently. The activities of CORE Organic should not stop, and efforts should be made to ensure follow-up.

Innovation with a tangible impact is a key objective of Horizon 2020. The EIP-AGRI is attempting to achieve this by fostering multi-actor cooperation which it expects to deliver solutions that are not only adapted to the needs of practitioners, but are also easy to implement. Indeed, innovation works best when the divisions between knowledge producers, users and brokers, and decision-makers are broken down. The organic sector provides a good basis for engagement in such interactive innovation processes. Organic farmers have traditionally needed to seek new ways of innovating, because the mainstream systems of agricultural research and advice did not address their needs. This encouraged farmers and scientists to collaborate closely in participatory research.

To sum up, increased investment in research and innovation for the organic food and farming sector has much to offer, not only in terms of designing more sustainable production systems, but also for the design of new and resilient business models and cooperation among stakeholders across the value chain.

REFERENCES

- Altieri MA (2002). Agroecology: the science of natural resource management for poor farmers in marginal environments. Agriculture, Ecosystems and Environment 93, 1-24.
- Altieri MA, Koohafkan P, Nicholls C (2014). Strengthening resilience of modern farming systems: a key prerequisite for sustainable agricultural production in an era of climate change. TWN Briefing Paper 70. Third World Network, 8 p.
- Altieri MA, Nicholls CI (2004). Biodiversity and Pest Management in Agroecosystems. 2nd edition. Haworth Press, New York.
- Beintema N, Stads GJ, Fuglie K et al. (2012). ASTI Global Assessment of Agricultural R&D Spending. Developing Countries Accelerate Investment. International Food Policy Research Institute, Washington, DC; Agricultural Science and Technology Indicators, Rome; Global Forum on Agricultural Research, Rome, 17 p. Available at http://www.ifpri.org/sites/default/files/publications/astiglobalassessment.pdf
- Bellon S, Lamine C, Ollivier G , de Abreu LS (2011). The relationships between organic farming and agroecology. 3rd ISOFAR Scientific Conference - 17th IFOAM Organic World Congress, Gyeonggi Paldang, 2011. Organic is Life. Knowledge for tomorrow: proceedings. ISOFAR, Bonn, p. 235-238.
- Bommarco R, Kleijn D, Potts SG (2013). Ecological intensification: harnessing ecosystem services for food security. Trends in Ecology and Evolution 28(4), 230-238. Available at http://www.cell.com/trends/ecology-evolution/abstract/S0169-5347(12)00273-X
- Buckwell A, Nordang Uhre A, Williams A, Poláková J, Blum WEH, Schiefer J, Lair GL, Heissenhuber A, Schießl P, Krämer C, Haber W (2014). Sustainable Intensification of European Agriculture. RISE Foundation, Brussels, 96 p.
- Council Regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products and repealing Regulation (EEC) No 2092/91. Official Journal of the European Union, p. 189/1-189/23. Available at http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:189:0001:0023:EN:PDF
- Cuijpers W, Koopmans C, Erisman JW (2013). Building on Resilience, Principles for Sustainable Agriculture: a draft framework. Publication nr. 2013-026 LbP. Louis Bolk Institute, Driebergen, 47 p.
- De Ponti T, Rijk B, Van Ittersum MK (2012). The crop yield gap between organic and conventional agriculture. Agricultural Systems 108, 1-9.
- De Schutter O (2010). Report submitted by the Special Rapporteur on the Right to Food. United Nations General Assembly. Human Rights Council, sixteenth session, agenda item 3 (A/HRC/16/49), 21 p.
- Dogliotti S, Garcis MC, Peluffo S et al. (2014). Co-innovation of family farm systems. A system approach to sustainable agriculture. Agricultural Systems 126, 76-86.
- EIP-AGRI (2014). Website available at www.eip-agri.eu
- Erisman JW, Cuijpers W, Koopmans CJ (2014). Biodiversity and food security (in prep.).
- European Commission (2013). Horizon 2020. Work Programme 2014-2015. Food security, sustainable agriculture and forestry, marine and maritime and inland water research and the bioeconomy. European Commission, Brussels, 87 p. Available at http://ec.europa.eu/research/participants/data/ref/h2020/wp/2014_2015/main/h2020-wp1415-food_en.pdf
- European Commission (2014a). Proposal for a regulation of the European Parliament and of the Council on organic production and labelling of organic products, amending Regulation (EU) No XXX/XXX of the European Parliament and of the Council [Official controls Regulation] and repealing Council Regulation (EC) No 834/2007. COM(2014) 180 final. European Commission, Brussels, 73 p. Available at http://ec.europa.eu/agriculture/organic/documents/eu-policy/policy-development/report-and-annexes/proposal_en.pdf
- European Commission (2014b). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Action Plan for the Future of Organic Production in the European Union. COM(2014) 179 final. European Commission, Brussels, 12 p. Available at http://ec.europa.eu/agriculture/organic/documents/eu-policy/european-action-plan/act_en.pdf
- European Commission (2014c). Guidelines on programming for innovation and the implementation of the EIP for Agricultural Productivity and Sustainability. European Commission, Brussels, 21 p. Available at http://ec.europa.eu/eip/agriculture/sites/agri-eip/files/eip-guidelines-july-2014_en.pdf
- EU-SCAR (2011). Sustainable Food Consumption and Production in a Resource Constrained World. European Commission, Brussels, 149 p.
- FAO (2009a). World Summit on Food Security. Rome, 2009. More information at http://www.fao.org/wsfs/world-summit/en/?no_cache=1
- FAO (2009b). Glossary on Organic Agriculture. Version 1.0 (15.10.09) (EFS). FAO, Rome, 150 p. Available at ftp://ftp.fao.org/docrep/fao/012/k4987t/k4987t01.pdf
- FAO (2014). International Symposium on Agroecology for Food Security and Nutrition. Rome, 2014. More information at http://www.fao.org/about/meetings/afns/en/
- High-Level Steering Board of EIP-AGRI (2014). Strategic Implementation Plan of the European Innovation Partnership for Agricultural Productivity and Sustainability. European Commission, Brussels, 27 p. Available at http://ec.europa.eu/eip/agriculture/sites/agri-eip/files/strategic-implementation-plan_en.pdf
- Hine R, Pretty J, Twarog S (2008). Organic Agriculture and Food Security in Africa. United Nations, Geneva and New York (UNCTAD/DITC/TED/2007/15), 61 p.
- IAASTD (2008). Agriculture at a Crossroads. Global Report from the International Assessment of Agricultural Knowledge, Science and Technology for Development. Island Press, Washington DC, 590 p.
- IDEA Consult (2008). Evaluation of the European Technology Platforms (ETPs). Final report. Ref. nr. BUDG06/PO/01/Lot 3. IDEA Consult, Brussels, 147 p.
- Kahl J, Alborzi F, Beck A, Bügel S, Busscher N, Geier U, Matt D, Meischner T, Paoletti F, Pehme S, Ploeger A, Rembiałkowska E, Schmid O, Strassner C, Taupier-Letage B, Załęcka A (2014). Organic food processing: a framework for concept, starting definitions and evaluation. Journal of the Science of Food and Agriculture 94(13), 2582–2594.
- Kahl J, Baars T, Bügel S, Busscher N, Huber M, Kusche D, Rembiałkowska E, Schmid O, Seidel K, Taupier-Letage B, Velimirov A, Załęcka A (2012). Organic food quality: a framework for concept, definition and evaluation from the European perspective. Journal of the Science of Food and Agriculture 92(14), 2760–2765.
- Koutsouris A (2012). Facilitating Agricultural Innovation Systems: a critical realist approach. Studies in Agricultural Economics 114, 64-70.
- Leeuwis C (1999). Integral design: innovation in agriculture and resource management. Mansholt Studies Series nr. 15. Mansholt Institute, Backhuys Publishers, 227 p.
- Lin BB (2011). Resilience in agriculture through crop diversification: adaptive management for environmental change. BioScience 61, 183-193.
- Mäder P, Fließbach A, Dubois D et al. (2002). Soil fertility and biodiversity in organic farming. Science 296, 1694-1697.
- Meredith S, Willer H (eds.) (2014). Organic in Europe. Prospects and Developments. IFOAM EU Group, Brussels; FiBL, Frick; CIHEAM-IAMB, Bari, 211 p.
- Millennium Ecosystem Assessment (2005). Reports available at http://www.millenniumassessment.org/en/index.aspx
- Niggli U (2014). Sustainability of organic food production: challenges and innovations. Proceedings of the Nutrition Society. Available on CJO2014. doi:10.1017/S0029665114001438.
- Niggli U, Slabe A, Halberg N et al. (2008). Vision for an Organic Food and Farming Research Agenda to 2025. IFOAM EU Group, Brussels and FiBL, Frick, 48 p.
- Ponisio LC, M'Gonigle LK, Mace KC, Palomino J, de Valpine P, Kremen C (2015). Diversification practices reduce organic to conventional yield gap. Proceedings of the Royal Society B 282. Available on http://dx.doi.org/10.1098/rspb.2014.1396
- Rockström J, Steffen W, Noone K et al. (2009). A safe operating space for humanity. Nature 461, 472-475.
- Schmid O, Padel S, Halberg N, Huber M, Darnhofer I, Micheloni C, Koopmans C, Bügel S, Stopes C, Willer H, Schlüter M, Cuoco E (2009). Strategic Research Agenda for Organic Food and Farming. TP Organics, Brussels, 116 p.
- Seufert V, Ramankutty N, Foley JA (2012). Comparing the yields of organic and conventional agriculture. Nature 485, 229-232. Available on doi:10.1038/nature11069.
- The Royal Society (2009). Reaping the Benefits: Science and the Sustainable Intensification of Global Agriculture. The Royal Society, London, 72 p.
- Tittonell PA (2013). Farming Systems Ecology. Towards ecological intensification of world agriculture. Inaugural lecture upon taking up the position of Chair in Farming Systems Ecology at Wageningen University on 16 May 2013. Wageningen University, Wageningen, 40 p.

MEMBERS AND SUPPORTERS OF TP ORGANICS

Umbrella organisations and international networks

AgriBioMediteraneo
www.ifoam.org/en/regional-activities/ifoam-agribiomediterraneo

APRODEV
www.aprodev.eu

BirdLife Europe
www.birdlife.org/europe-and-central-asia

Copa-Cogeca
www.copa-cogeca.be
Partner organisation for research theme eco-functional intensification

Danube Soya
www.donausoja.org

ECOLOGICA
www.ecologica.mobi

Euro Coop
www.eurocoop.org

Eurogroup for Animals
www.eurogroupforanimals.org

Euromontana
www.euromontana.org

European Agroforestry Federation (EURAF)
www.agroforestry.eu

European Coordination Via Campesina (ECVC)
www.eurovia.org

European Council of Young Farmers (CEJA)
www.ceja.eu

European Environmental Bureau (EEB)
www.eeb.org

European Federation of Food, Agriculture and Tourism Trade Unions (EFFAT)
www.effat.org

European Landowners Organization (ELO)
www.europeanlandowners.org

European Organic Certifiers Council (EOCC)
www.eocc.nu

Fédération Européenne du Cheval de Trait pour la promotion de son Utilisation (FECTU)
www.fectu.org

Fondation Sciences Citoyennes
www.sciencescitoyennes.org

Friends of the Earth Europe
www.foeeurope.org

Greenpeace-EU Unit
www.greenpeace.org/eu-unit/en

Innovation for Development and South-South Cooperation (IDEASS)
www.ideassonline.org

International Federation of Organic Agriculture Movements - EU Group (IFOAM EU)
www.ifoam-eu.org

International Links and Services for Local Economic Development Agencies (ILSLEDA)
www.ilsleda.org

International Research Network for Organic Food Quality and Health (FQH)
www.fqhresearch.org

International Society of Organic Agriculture Research (ISOFAR)
www.isofar.org

Pesticide Action Network Europe
www.pan-europe.info

Regional Rural Development Standing Working Group of South Eastern Europe (SWG RRD)
www.seerural.org

Active enterprise members

3R Agrocarbon (HU)
www.3ragrocarbon.com

Agrano (DE)
www.agrano.de

Allos (DE)
www.allos.de

Ariza (NL)
www.ariza.nl

Bioland Markt (DE)
www.bioland-markt.de

Brio (IT)
www.briospa.com

Coato (ES)
www.coato.com

Comprobio (IT)
www.comprobio.net

EuCRF European Centre for Research & Financing (IL)
www.eu-crf.net

Freiland Puten (DE)
www.freiland-puten.de

La Colombaia (IT)
www.lacolombaia.it

Lebensbaum (DE)
www.lebensbaum.com

Mandala (BE)
www.mandalaorganicgrowers.com

Märkisches Landbrot (DE)
www.landbrot.de

Neumarkter Lammsbräu (DE)
www.lammsbraeu.de

Novamont S.p.A. (IT)
www.novamont.com

Ökoland (DE)
www.oekoland.de

Organic Farma Zdrowia (PL)
www.organicmarket.pl

Organic Potato Starch (LV/FI)
www.organicpotatostarch.com

Organic Services (DE)
www.organic-services.com

Praum (DE)
www.praum-zwieback.de

Sire (IT)
www.sirericevimenti.it

Sommer & Co (DE)
www.sommer-biscuits.de

Vox Net (IT)
www.voxnet.it

Xtrem Biotech (ES)
www.xtrembiotech.com

National cooperation partners

Agrobio (PT)
www.agrobio.pt

Assoziation ökologischer Lebensmittelhersteller - AöL (DE)
www.aoel.org

Bugday Association (TR)
www.bugdayglobal.org

Centro de Investigação de Montanha / Mountain Research Centre - CIMO (PT)
www.cimo.esa.ipb.pt

Georg-August Universität Göttingen - Section of Genetic Resources and Organic Plant Breeding (DE)
www.uni-goettingen.de/de/48392.html

Groupe de Recherche en Agriculture Biologique - GRAB (FR)
www.grab.fr

Interdisciplinary Agroecology Research Group of the FNRS - GIRAF (BE)
www.agroecologie.be

Schweisfurth Stiftung (DE)
www.schweisfurth.de

Sofia University SV. Kl. Ohridski - Department of Sociology (BG)
www.uni-sofia.bg

Soil Association (UK)
www.soilassociation.org

The Organic Research Centre – Elm Farm (UK)
www.organicresearchcentre.com

Verband der Landwirtschaftskammern (DE)
www.landwirtschaftskammern.de

National Technology Platforms

Bionext (NL)
www.bionext.nl

Czech Technology Platform for Organic Agriculture (CZ)
www.ctpez.cz

Italian Technology Platform for Organic Agriculture - PT Bio (IT)
www.ptbioitalia.it

Network for Organic Food and Farming Research - NOBL (BE)
www.nobl.be

Plataforma Tecnológica Agroecológica - PTA (ES)
www.agroecologia.net/pt-agroecologica

Swedish Centre for Organic Food and Farming - EPOK (SE)
www.slu.se/epok/english

Supporting members

Bioforsk (NO)
www.bioforsk.no

Bionext (NL)
www.bionext.nl

Consiglio Nazionale delle Ricerche - CNR (IT)
www.cnr.it

Czech Technology Platform for Organic Agriculture (CZ)
www.ctpez.cz

Eberswalde University for Sustainable Development (DE)
www.hnee.de

Estonian University of Life Sciences (EE)
www.emu.ee

Fondazione Italiana per la Ricerca in Agricoltura Biologica e Biodinamica - FIRAB (IT)
www.firab.it

GAL Terre di Murgia (IT)
www.galterredimurgia.it

International Centre for Research in Organic Food Systems - ICROFS (DK)
www.icrofs.org

International Federation of Organic Agriculture Movements - EU Group (IFOAM EU)
www.ifoam-eu.org

International Research Network for Organic Food Quality and Health (FQH)
www.fqhresearch.org

Kassel University (DE)
www.uni-kassel.de

Laboratory of History of Agro-ecosystems (ES)
www.historiambiental.org

Louis Bolk Institute (NL)
www.louisbolk.org

Mediterranean Agronomic Institute of Bari - CIHEAM-IAMB (IT)
www.iamb.it

Natural Resources Institute Finland - LUKE (FI)
www.luke.fi/en

Network for Organic Food and Farming Research - NOBL (BE)
www.nobl.be

Research Institute of Organic Agriculture - FiBL (CH)
www.fibl.org

RHEA (BE)
www.rhea-environment.org

Swedish University of Agricultural Sciences - SLU (SE)
www.slu.se

Technical University of Denmark - DTU (DK)
www.dtu.dk

Thünen Institute (DE)
www.ti.bund.de/en

Università Politecnica delle Marche - UNIVPM (IT)
www.univpm.it

University of Natural Resources and Life Sciences, Vienna - BOKU (AT)
www.boku.ac.at

Financial supporters

Ekhagastiftelsen
www.ekhagastiftelsen.se

Software AG Stiftung
www.software-ag-stiftung.de

This publication is co-financed by the European Union, Directorate-General for the Environment. The sole responsibility for this communication lies with the IFOAM EU Group. The European Commission is not responsible for any use that may be made of the information provided.

PUBLISHED BY

TP ORGANICS
RUE DU COMMERCE 124
1000 BRUSSELS
BELGIUM
PHONE: +32 (0)2 808 79 91
EMAIL: INFO@TPORGANICS.EU
WEBSITE: WWW.TPORGANICS.EU

TPorganics European Technology Platform

This publication is co-financed by the European Union, Directorate-General for the Environment. The sole responsibility for this communication lies with the IFOAM EU Group. The European Commission is not responsible for any use that may be made of the information provided.