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Swedish University of Agricultural Sciences

**EPOK – Centre for
Organic Food and Farming**

Research Agenda for Organic Agriculture 2013

Research challenges and knowledge requirements for organic food and farming

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EPOK

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Introduction

Successful organic production and increased consumption of organic food means there is a great need for new knowledge and new, innovative solutions within the entire organic food chain. Many of the knowledge needs and challenges are, however, general and independent of production forms. We are now facing the necessity of transforming our food production from a system based on fossil fuels to one that is more resource efficient. We need to develop production forms that can support a growing population, and are at the same time environmentally friendly, maintain the ecosystem services of agricultural land and utilize resources in a way that is sustainable in the long term. There are also growing expectations that agriculture will deliver other valuable products in addition to food[1]. Those engaged in organic agriculture have a responsibility to be part of this development and contribute to future solutions through research, development and innovation, in cooperation between stakeholders in the food chain.

This new Swedish research agenda for organic agriculture has been developed by EPOK in an open process together with interested parties in the food chain, as well as through dialogue with researchers and the research funding bodies. The agenda takes on the most important future challenges and knowledge needs of the organic food chain on the road towards increased sustainability, efficiency and environmental and sociatal benefits.

The main aim of the research agenda is to provide a well supported document which will enable the decision makers and research funding bodies to decide and prioritize future research ventures. Another important aim is to draw attention to relevant problems and inspire research into areas where knowledge is lacking.

The research agenda continues the work of coordinating research in organic agriculture that CUL – Centre for Sustainable Agriculture was previously responsible for[2]. The new agenda highlights previously topical areas of research that need continued research, but also prioritizes new research areas. The agenda also links in with international research programmes on organic agriculture, in particular the research agenda drawn up within the EU Technology Platform TP Organics[3] and the new Danish research strategy[4].

1 Formas, 2012. Swedish Research and Innovation Strategy for a Bio-based Economy. Report R3:2012, Formas, Stockholm.
2 SLU, 2010. Framework Programme for Research on Organic Production and Consumption 2010–2012. Swedish University of Agricultural Sciences, Uppsala.
3 TP Organics, 2009. Strategic Research Agenda for Organic Food and Farming, December 2009, <http://www.tporganics.eu>, 2013-01-21.
4 ICROFS, 2012. Research and development strategy 2012 in Organic farming and food – Growth, credibility and resilient systems, <http://www.icrofs.org/pdf/2012_web_UKforsknings-strategi_indmad.pdf>, 2013-01-21.

Overarching themes

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Three themes have been identified to describe the overall challenges that face organic agriculture and the organic food chain if production and consumption are to be developed and achieve an increased long-term sustainability.

▪ Robust systems

A more sustainable organic production and food chain need to reduce vulnerability and build on development of robust systems in biological, economic and societal terms. Production stability needs to be improved in crop production, livestock farming and aquatic systems, which will increase economic resilience. Businesses, both in primary production and along the entire food chain, need to be resilient against external disturbances and changes, climate change, market swings and varying political measures. Diversity and adaptability in time and place are keywords for robust systems.

The production system should provide conditions that maintain animal and plant health, where suitably adapted animal and plant materials are a component. Strong specialization can increase vulnerability, but resilience can be improved through cooperation and new ways of organizing production, processing and marketing. If the branch is to continue to evolve, a decision-making system is needed to develop innovative and adaptable businesses that can optimize their resources. Social resilience is also crucial for sustainable development with a safe and healthy work environment where competence is rewarded and developed and entrepreneurs remain in the branch. To achieve resilience in the widest terms, it is very important to improve interdisciplinary research, including both natural and social sciences.

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▪ Added value for the environment and society

The vision for organic agriculture is that it will contribute to a series of added values for the environment, animals and people, and it is based on a number of essential principles formulated through international dialogue[1]. The principles are the foundation for the EU regulations for organic agriculture[2] as well as the KRAV regulations[3] (KRAV – Swedish association for standards in organic agriculture and food) .

Research is needed to evaluate the contribution organic agriculture makes to these added values and how sustainability improvements could be made, both in the short and long term. Systems analyses, where many aspects are integrated, play an important role in research evaluating the sustainability of different production systems. This relates to reducing emissions of greenhouse gasses and increasing carbon storage in soil, to plant nutrition strategies that cause only a small release of nutrients that can contribute to eutrophication, to managing finite resources by closed-loop recycling and encouraging biodiversity in production systems and the countryside. It also means allowing animals free range for natural behaviour, furthering good animal health and environmentally friendly livestock production, and producing good quality food that promotes human health.

It is organic production's contribution to these added values that justifies the EU subsidy payments to organic farming. Credibility for this positive contribution to environmental and societal benefits is also essential for consumer interest in organic food and other organic products and for their willingness to pay extra for organic compared to conventional products. Another objective of research is that organic production and the organic food chain will become a powerful instrument for developing new methods and systems to achieve more sustainable agricultural systems as a whole.

1 IFOAM, 2012. <http://www.ifoam.org>, 2013-01-21.
2 European Council, 2007. Council regulation (EC) No 834/2007 of 28 June 2007 on organic production and labelling of organic products.
3 KRAV, 2012. Standards for KRAV-certified production. <http://www.krav.se/KravsRegler/>, 2013-01-21.

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PHOTO: MARTIN CEJIE HEGART / KRAV

PHOTO: ANNA WALLENBECK

PHOTO: PETER ANDERSON

▪ Competitiveness and thriving rural communities

A challenge for organic food production is to increase competitiveness through improved profitability, greater volume and a larger variety of products. There is a need for more knowledge about policy instruments such as the formulation of agri-environment payments, and their effect on businesses' profitability and competitiveness.

New methods of production, technological development and production systems that lead to higher productivity are naturally important for a business's competitiveness and survival. More processing and development of new products can also increase profitability for agricultural businesses by opening new markets for their raw materials. Knowledge of the added value of organic products needs to be improved and communicated throughout the food chain to develop the market. There must also be an accord between the supply of organic products with documented added value and consumer preferences so that higher prices can be charged.

A growing organic food sector can be a driving force for social and economic development in rural communities as new business opportunities are created. More cooperation, innovative forms of organisation, new activities outside the area of food production and close relations with consumers in a local food market can contribute to rural development.

Focal Areas

Based on the overarching themes: robust systems, added value for the environment and society, and competitiveness and thriving rural communities, five focal areas have been defined. The focal areas and the examples of research areas described arise from research ideas and knowledge needs identified by all those participating in the process of formulating this research agenda.

1. *High productivity and maintained sustainability*
2. *Innovative production systems with many functions*
3. *Closed-loop cycles and renewable resources*
4. *Sustainable businesses and development of markets*
5. *Healthy food with added value*

The focal areas cover the entire food chain, from primary production, processing and the market to consumption of organic food. The suggestions deal with both short-term issues and long-term challenges and spans from the sector's to a society-orientated perspective.

PHOTO: CAMILLA WINQVIST

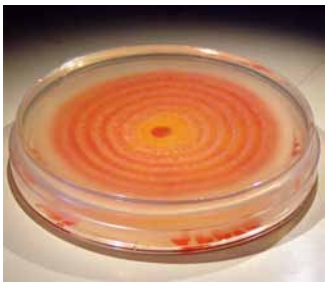

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PHOTO: PELLE FREDRIKSSON

1. High productivity with maintained sustainability

Today organic production faces a number of great challenges in achieving higher and more stable levels of production and increased productivity. This applies to all branches of production: crop production, livestock farming, greenhouse production or aquaculture. At the same time production should have a low environmental impact, animal welfare must be assured, products should be safe and of high quality, and the production system should strengthen ecosystem functions and improve soil fertility. Production improvements should therefore maintain the added value, and in many cases an increase in productivity will go hand in hand with a low environmental impact, for example by reducing spread of antibiotic-resistant bacteria, by reducing losses of nutrients and a more efficient use of resources.

A bottle neck for more stable production levels are the different crop protection problems; considerable knowledge is needed about new, more effective non-chemical methods, which need to be suited to the crop rotation and other measures in the production system. With a changing and more varied climate, flexible crop protection strategies, whereby methods of control are combined, will become ever more important. As a result of the forthcoming requirement that integrated crop protection be applied within the EU, non-chemical crop protection methods are also of great interest in conventional production. New, suitable fertilizers and plant material, not least nitrogen-fixing legumes that have a central role in organic production, suited to the production environment are central to productivity and resource utilization.

To achieve increased productivity as well as healthy livestock, strategies are needed for effective and balanced feeding with optimal feed utilization, also combining grazing. Sustainable feeding solutions in aquaculture is also a large area requiring new research. Another important area concerns the possibilities and effects of using locally produced feed and domestically produced protein feed. Livestock breeds that are genetically adapted to production conditions are fundamental for both productivity, animal health and economy.

In research that is closely related to production, collaboration between advisers, farmers and other branch entrepreneurs provides significant advantages in developing and implementing relevant methods and solutions, while advantage is taken of the experience and creativity of the entrepreneurs. This focal area is weighted towards short-term knowledge needs and points out the bottle necks for more sustainable and competitive production.

Examples of research areas:

- Plant material, intercropping combinations, and mixtures of varieties with multifunctional characteristics
- Technological and machine development in context of the biological preconditions to increase efficiency and precision in weed control
- The benefits of biological diversity in production, measures that contribute to the control of pests
- Production strategies and technology for sustainable nutrient supply with the aim of (i) supporting biological processes in the crop rotation and (ii) improving utilization of plant nutrients in organic waste products
- Reliable legume crops and legume-rich crop rotations for locally produced and processed protein animal feed and food products
- Measures for high quality roughage feed suitable for different livestock categories and development of feed assessment and feeding strategies
- Grazing strategies for high production, good animal health, good working environment and large biological diversity
- Effects of livestock housing systems and preventative animal health measures on livestock health and production results
- Breeding programmes for increased lifespan and the interplay between breed and type of production system

2. Innovative production systems with many functions

Research is needed on the design of organic production systems in which many aspects are weighed in and the different processes and parts of the system are studied from a holistic perspective. More needs to be known about building up multifunctional production systems that utilize local resources and are both productive and sustainable. Studies of systems enable us to study and find solutions for conflicts of aims, such as the balance between production level, use of resources, consideration for the environment, animal welfare and the quality of animal feed and food products, as well as evaluating the sustainability of the whole system. Interactions with the surrounding countryside are important for development of a biodiversity that improves the cultivated land's ability to provide ecosystem services such as pollination and biological control.

One way to strengthen production systems in the long term is to find new solutions to strengthen collaboration between farms. This can be cooperation between farms with different types of production, a cooperation enabling more efficient use of resources, a better psychosocial work environment, more efficient cycling of nutrients and more variety in crop rotations.

An interdisciplinary approach is needed to study and develop new systems solutions, and research in this area is seen as more long term. Conditions for developing innovative ideas need to be created in research projects where researchers from different disciplines, farmers, other entrepreneurs from the branch and organisations meet.

Examples of research areas:

- Design of systems with greater diversity and multifunctionality and new models of intercropping
- New resource conserving cropping systems without livestock to reduce environmental and climate impact through production of plant food products and biomass for bioenergy
- Climate smart livestock systems where animals can go outside and that favour carbon storage, an efficient use of resources, while considering product quality, animal welfare as well as economics
- Design of cropping systems strengthening functional biological interactions such as suppression of pests and biological control by natural enemies and antagonists
- Evaluation of long-term effects of different types of organic production systems on biodiversity and ecosystem services.
- Breeding goals for crops and livestock adapted to production systems that make extensive use of local resources and where animals can go outside
- Livestock rearing systems where grazing on natural pasture is combined with other feeding strategies and selection of livestock breeds for profitable production and environmental benefits.
- Models of cooperation, for example between arable and dairy farms, between vegetable growers and poultry producers and between aquaculture and different kinds of agricultural production

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3. Closed-loop nutrient cycles and renewable resources

To achieve long-term sustainable production and safeguarding long-term supplies of plant nutrients in organic production, there needs to be more recycling of nutrients and other materials, both within agriculture and between town and country. Increased nutrient cycling is important both for economizing with finite resources and to reduce environmental impacts. The possibilities and impediments (not least the regulations for organic production) at different levels in the organic food chain also need to be investigated to bring about developments leading to an expanded nutrient cycle between town and country, where also sewage products could be part of the nutrient supply in organic production.

Plant nutrient sources in the form of waste products from communities and the food industry that meet quality requirements and that are permitted for use in organic production are limited, which means that there is an urgent need for increased, resource-efficient and secure recycling.

A great challenge for the future concerns new energy-efficient solutions in the entire food chain and a transition to renewable energy. Knowledge is needed about how biomass production and local/regional energy production can be integrated with organic agriculture, in particular solutions for production of biogas and the return of residues to arable land. Research is needed on rest products and raw materials of the right quality for energy production, as well as technological and logistic solutions for energy production.

PHOTO: PELLE FREDRIKSSON

Examples of research areas:

- Technology and logistics to facilitate the cycle of feed and manure between and on farms
- Handling, quality assurance and usefulness of traditional and newer types of products from industry and society's waste and sewage products
- Infrastructure, stakeholder cooperation and political means to realise optimal cycling solutions
- New production systems and new technology that integrate production of food and of raw materials for energy production – analysis of resource use for different system solutions
- Methods to reduce waste of primary agricultural productions and food, use of a larger proportion of primary products for other purposes, using by-products/waste products for animal feed and as raw materials for energy production
- Use of the products of recycling for hobby growing and other organic small-scale growing in and near towns

4. Sustainable enterprises and market development

To achieve a stable market development, there must be ready availability of goods and products of a quality that meet consumer demand at a price consumers are prepared to pay. More knowledge is needed about consumer opinions of and attitudes to production methods and livestock management in organic production, and readiness to pay for organic food, and which aspects of food quality are demanded. There is a need for knowledge of the conditions and opportunities for and limitations to cooperation between partners in the food chain, and also for developing methods of knowledge transfer to and communication between entrepreneurs. Effective policy instruments need to be developed and evaluated to stimulate competitiveness among entrepreneurs who contribute to the market for food with added value. This includes tools for analysis of how the extra price asked for organic products benefits businesses along the entire food chain.

A more consistent production flow and greater volume is required to expand the assortment of processed organic products. New distribution systems need to be developed that can deal with larger volumes than the models for small-scale distribution, such as farmers' markets and organic box schemes, which exist today. Business economic analysis of different sales strategies is needed.

To increase businesses' competitiveness, knowledge is needed about handling production and market risks specific to organic production. New organisational and cooperative forms, both in primary production and in marketing and processing need to be developed to increase profitability and decrease vulnerability.

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Examples of research areas:

- Barriers and opportunities for businesses to produce and process organic products – economic, structural and social factors, knowledge and advisory requirements
- Economic risk analysis for different types of production as a decision basis for converting to organic production
- Risks and opportunities for larger production volumes and less uniformity of raw materials
- Resource management throughout the food chain, and effects of different distribution systems
- Stakeholder cooperation in food processing for product development and increased supply
- The effect of different certification systems on market development and consumer demand
- Maintaining added value throughout the entire food chain through better communication and knowledge transfer
- Consumer buying behaviour based on assessment of and preferences for different added values

5. Healthy food with added value

More needs to be understood about the underlying mechanisms affecting the characteristics of different foods and the effects of the production system and of different production methods. Studies are also needed of food processing with low resource consumption and environmental impact in which food quality is maintained and strengthened. Certain differences in quality between organic and conventional products, such as whether they contain particular nutrients or pesticide residues, have been fairly well investigated, but there are still a large number of substances that is poorly studied. Knowledge is also lacking of how organic food affect health and where food effects can be separated from other factors that influence human health, such as life style.

In a complex food market, consumers need reliable information about the added value of organic production (use of resources, environmental impact, impact on biological diversity, animal welfare, food quality and health effects) to be able to make informed choices. Similarly, politicians and other decision makers need such information in order to make decisions. Consumer preferences also need to be fed back to different links in the food chain so that agriculture and processing industries will produce the food demanded and that consumers are willing to pay more for.

Example of research areas:

- How quality and composition of organic food is affected by growing conditions, production methods and farming systems
- Mechanisms that affect quality through the food chain
- Methods and systems to characterize food quality, multi-methods instead of analysis of single substances
- Food safety and traceability through the whole food chain
- Effects on consumer health of organic versus conventional food
- Understanding consumer assessment and behaviour
- Dissemination of knowledge to consumers and decision makers to enable them to make informed choices and decisions
- New ways of market communication

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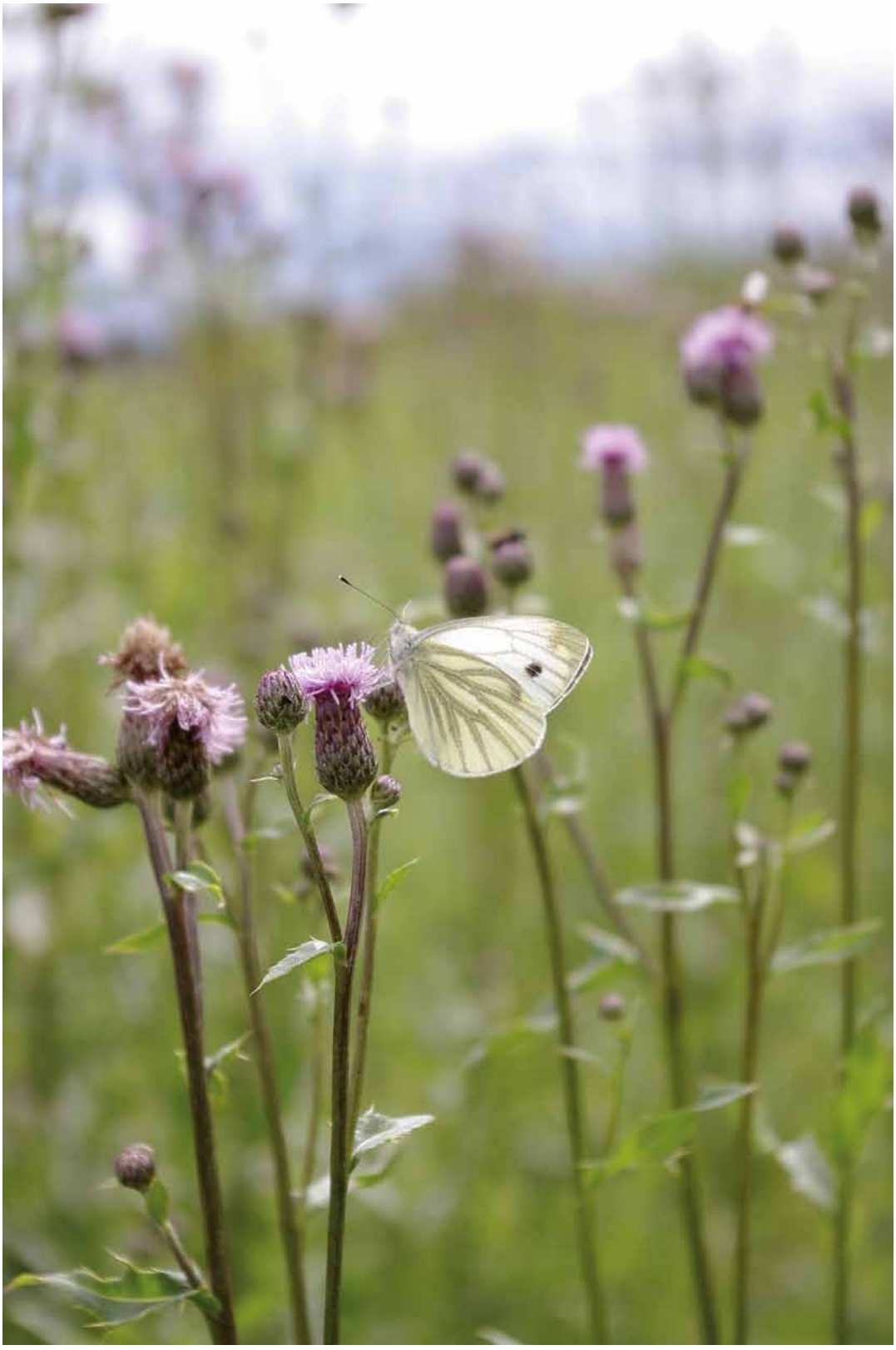

PHOTO: CAMILLA WINQVIST

Background

Research on organic agriculture

Swedish research in organic food and farming has for the last 15 years been mainly financed through specially designated funding, provided by the Swedish Research Council Formas, SLU EkoForsk and the Swedish Board of Agriculture that have invited research applications in this area. The Swedish Farmers' Association for Agricultural Research and the Ekhaga Foundation have also financed research in organic agriculture.

Research in organic agriculture has been carried out in a variety of different areas since the end of the 1990s. An evaluation of organic research from 1997 to 2006 shows that approximately half of the funding was allocated to research in crop production, crop protection and soil science, while approximately a quarter went to livestock projects[1]. Less than 10 per cent of funding went to projects with a socio-economic focus. Since 2006 only a few socio-economic projects in the organic agriculture area have received funding. Recently funding has been awarded to a number of projects related to biodiversity and ecosystem services, as well as projects addressing renewable energy and cycling of urban waste products. Projects concerned with livestock have also increased in the latest allocations of funding.

Despite there having been an awareness for a considerable length of time of the need for larger interdisciplinary projects to achieve sustainable solutions for organic food production, in which conflicts of aims can be managed, few such pro-

PHOTO: JENNY DJURBERG

jects have got off the ground. Increased international cooperation will improve the prospects for such research.

Quality and benefits of research in organic agriculture

The above mentioned evaluation of research in organic production and consumption[1] showed that approximately half of the projects were of a high scientific standard. At the same time approximately a quarter of the projects were judged to be of too low a standard to contribute to science-based knowledge, in particular due to an insufficient number of scientific publications. A more recent analysis assessed productivity of the evaluated projects in terms of scientific publications in peer-reviewed international journals. The analysis showed that in the field of organic agriculture there were more publications than in the other research fields evaluated: 0.9 articles per million Swedish kronor invested in the research, compared with the average for Swedish universities and university colleges for biology which was 0.6 articles per million Swedish kronor[2].

The projects' relevance was also assessed, and was found to be high for organic agriculture and somewhat lower regarding relevance for agriculture as a whole[1]. Organic research programmes have from early on focussed on a number of profile areas. As a result a large amount of knowledge has been produced in these areas that has been very important to the development of successful organic production, but has also been important to agriculture as a whole. One of these areas is non-chemical means to control weeds and organisms harmful to crops, which has generated fundamental biological and ecological knowledge, and has also led to the development of innovative mechanical and biological control methods. Energy-efficient and effective mechanical weed control is one example, biological control using natural enemies and antagonistic microorganisms is another. Research concerning more efficient nutrient cycles, partly in agriculture and partly regarding urban waste products and their usability in crop production has also contributed to development of organic farming systems, and to knowledge that has a broader relevance.

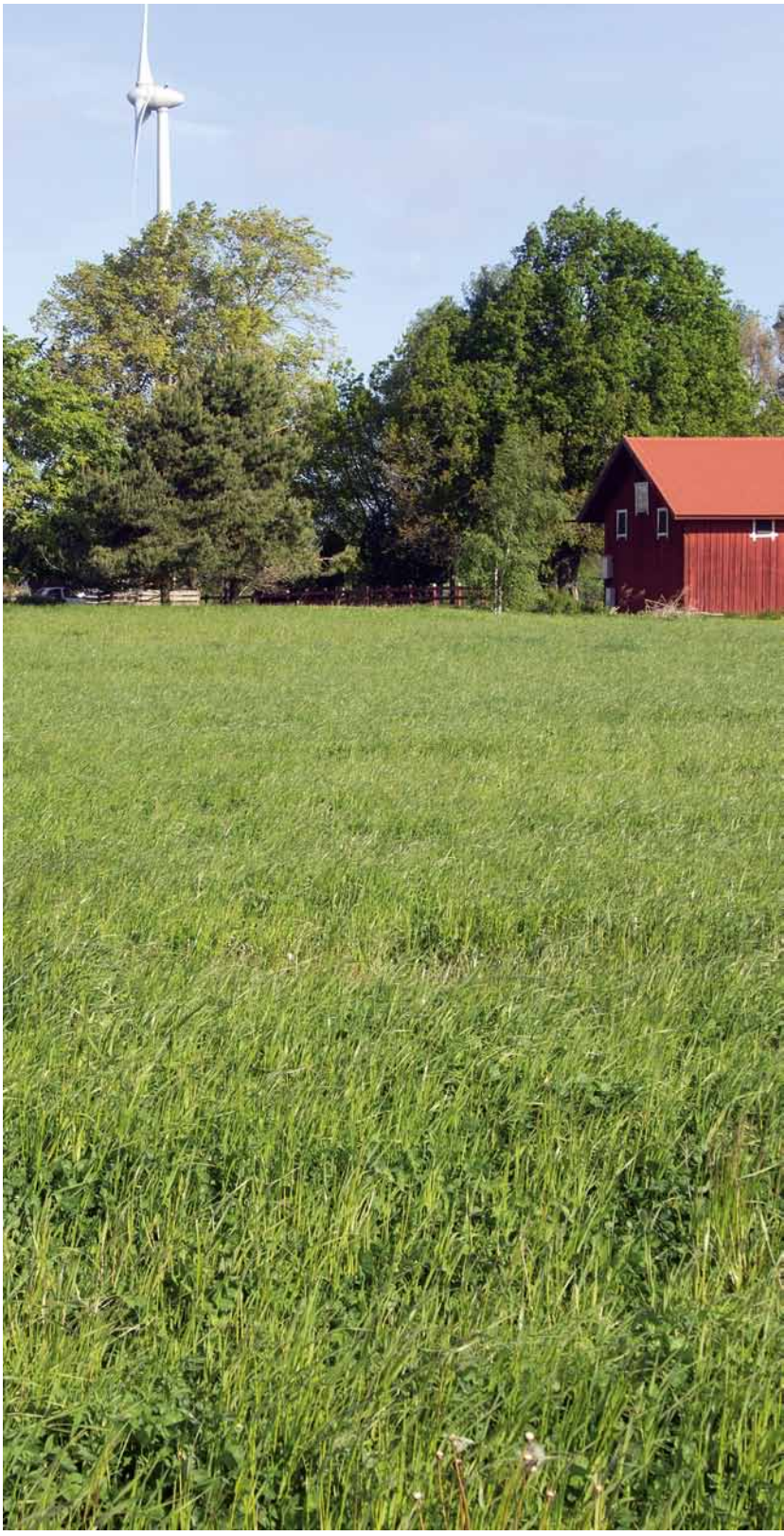

PHOTO: PELLE FREDRIKSSON

Animal health and welfare are important as added value in organic production, and new issues regarding livestock housing, access to outdoors and pasturing that encourage natural behaviour among livestock have been initiated in organic research and contribute to knowledge that is valuable to Swedish livestock farming as a whole. Furthermore, research into locally produced animal feed and domestic protein feed production is important for all Swedish livestock farming regardless of production system.

An exhaustive evaluation of the effects for the branch and society of research in organic agriculture in Denmark concluded that the research has had a large effect on the organic sector's development and that the results have also contributed to a green conversion of conventional agriculture[3]. Danish organic research has spearheaded an improvement in the environmental profile of Danish agriculture. Among areas of particular importance mentioned are methods for reducing chemical seed dressing, non-chemical weed control and methods that can reduce the use of antibiotics in livestock farming.

National objectives for organic production have existed since the middle of the 1990s, and the most recent objective was that 20 per cent of Sweden's agricultural land would be certified organic by the end of 2010. This production objective has been extended until the end of 2013 when new decisions will be made on objectives for organic agriculture. The aim of the national objectives and the subsidies for organic production linked to them are the environmental and societal benefits that such production generates. In an investigation of new objectives for organic production, The Swedish Board of Agriculture concluded that this system contributes to increased biodiversity and decreased use of chemical plant protection products with reduced risks to the environment and health as a result[4]. In addition, it was concluded that organic production has benefits for animal welfare and rural development.

Research in the organic food chain is delivering knowledge that reveals new possibilities and alternative development routes. A plurality of knowledge development in different production systems is likely to be very important as we face an uncertain future with environmental threats, limited resources and immense challenges for food supply and food security.

International cooperation for improved quality

During the 15 years that research funds have been earmarked for research into organic agriculture in Sweden there has been a similar development in many other European countries and international cooperation has become ever more important. Formas' evaluation from 2006[1] notes that it is very important that Swedish research in this area becomes more visible outside of Sweden's borders, and that more effort should be put into international research cooperation.

International cooperation has, however, intensified since the evaluation was published and it is important that this development continues in order to improve quality and make better use of research

PHOTO: MARIA WIVSTAD

resources. Funding of research in organic agriculture through the ERA-net CORE Organic has been significant and there is Swedish participation in four of 11 projects in the second phase, CORE Organic II[5]. A review of EU-funded agricultural research including organic agriculture emphasizes the importance of research cooperation in CORE Organic for knowledge development in the organic food chain[6]. Two main arguments are set out for the importance of maintaining resources for European coordination of research on organic agriculture and organic food: 1) serious challenges within food production are in common and not limited by national borders, 2) several areas require large research resources. The extent of Swedish participation in these international coordinated projects depends, however, entirely on the amount of funding that Formas allocates. Research in organic agriculture is also funded to a certain extent within the EU's large framework programmes . International cooperation in Swedish-based projects is another important contribution to the internationalization of research.

Stakeholder cooperation to strengthen innovation and implementation

The need for more cooperation between research and stakeholders in the food chain and communities in order to increase the benefits of research to society is increasingly being discussed. In the area of organic agriculture cooperation has traditionally been strong, in particular because organic farmers have seen a large need for new knowledge and innovations and consequently they have been involved in research and development issues. Previous research programmes for organic agriculture, Formas' evaluation 2006, the EU platform TP Organics 2009 and the Danish research strategy 2012 all emphasize the importance of cooperation between research, practice and interested parties such as farmers, machine manufacturers, processing industries, commerce and consumer organisations in order to improve the practical application of research results and to promote innovation and development of more sustainable production systems and solutions throughout the food chain.

1 Formas, 2006. Evaluation of research on organic production in Sweden. Evaluation Report 2006, Formas, Stockholm.
2 Nohrstedt, H-Ö, 2009. Forskningens produktivitet. Fem exempel från Formas utvärderingar, Formas, <http://www.formas.se/PageFiles/4880/Forskningens%20produktivitet.pdf>, 2013-01-21. *(In Swedish)*
3 ICROFS 2012. Organic research and development 1996-2010 – effects on industry and society, <http://www.icrofs.org/pdf/2012_web_UK_oekoanalyse.pdf>, 2013-01-22.
4 Jordbruksverket, 2012. Behov av nya mål och åtgärder för ekologisk produktion i landsbygdsprogrammet. *(In Swedish)*
5 CORE organic II <http://www.coreorganic2.org/> 2013-01-21.
6 European Commission, 2012. A decade of EU-funded, low-input and organic agricultural research (2000-2012). Directorate-General for Research and Innovation, Biotechnologies, Agriculture, Food, Brussels.

Method for developing the research agenda

The research agenda was produced by EPOK during 2012. The involvement of numerous stakeholders enabled a broad view of the issues and identification of the need for new knowledge in the organic food chain, from primary production and marketing questions to what people need to know about organic agriculture's beneficial contribution to the environment and society. EPOK has held workshops on specific subjects and carried out needs analyses with participants from public authorities, industry, and producer and advisory organisations. EPOK has also participated at Swedish agricultural exhibitions, arranged meetings for various stakeholders, for example farmers and advisers, where participants were able to contribute with their own knowledge requirements. EPOK has carried out a survey of knowledge needs which resulted in responses from 11 branch organisations, 2 authorities, 7 advisory organisations and 15 departments at the Swedish University of Agricultural Sciences. The research agenda has been referred back to stakeholders for consideration and their standpoints have been taken into account in the final version.

This new Swedish research agenda for organic agriculture has been developed by EPOK in an open process together with interested parties in the food chain, as well as through dialogue with researchers and the research funding bodies. The agenda takes on the most important future challenges and knowledge needs of the organic food chain on the road towards increased sustainability, efficiency and environmental and sociatal benefits.

The main aim of the research agenda is to provide a well supported document which will enable the decision makers and research funding bodies to decide and prioritize future research ventures. Another important aim is to draw attention to relevant problems and inspire research into areas where knowledge is lacking.

The agenda also links in with international research programmes on organic agriculture, in particular the research agenda drawn up within the EU Technology Platform TP Organics and the new Danish research strategy.

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