ORGANIC TARGETS 4EU

Transformation scenarios for boosting organic farming and organic aquaculture towards the Farm-to-Fork targets

Deliverable 1.1
Assessment of the knowledge and innovation systems for organic agriculture, aquaculture and value chain actors

Type: Public

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Abbreviations

AKIS - Agricultural Knowledge and Innovation System

AOeL - Assoziation ökologischer Lebensmittel Hersteller e.V.

AIAB - Associazione Italiana per L'Agricoltura Biologica

B2B - Business to business

BIOBASE-OK-NET - online knowledge-sharing platform

Biokultúra - Hungarian Association of Organic Farmers

BLE - Federal Office for Agriculture and Food Germany

BMEL - Federal Ministry of Food and Agriculture in Germany

BMELV - Federal Ministry of Food, Agriculture and Consumer Protection

BNN - Bundesverband Naturkost Naturwaren

BÖL(N) - Federal Programmeme for organic farming in Germany

CAP - Common Agricultural Policy

CAP SP - Common Agricultural Policy Strategic Plan

CASDAR - Public funds from the Ministry of Agriculture in France

CDA - advisory structure in France rival to GAB

CDAF network - Network of Chambers of Agriculture in France

CIVAM - Centres d'initiatives pour valoriser l'agriculture et le milieu rural in France

CSAB - Organic Agriculture Scientific National Committee

DAFA - Deutsche Agrarforschungsallianz

ECOPHYTO - online knowledge-sharing platform

EIP-AGRI - European Innovation Partnership for Agricultural Productivity and Sustainability

EIP-AGRI OGs – Operational Groups of the European Innovation Partnership for Agricultural Productivity and Sustainability

F2F – Farm to Fork Strategy

Federbio - Federazione Italian agricoltura biologica e biodinamica

FIBL - Research Institute of Organic Agriculture

FNAB - Network of organic farmers' groups in France under GAB advisory structure

GAB - advisory structure in France rival to CDA

GECO dev–ce - online knowledge-sharing platform

GIS - Groupement d'Intérêt Scientifique,

GIS - Groupement d'Intérêt Scientifique

GUDP - Ministry of Environment and Food of Denmark

IACS - Intelligent Automation Control System

ICOEL - Danish Innovation Centre for Organic Farming

ICROFS - Danish Coordinating Body of the National Research Programmemes concerning organic farming and food systems (The Organic RDD-programmemes)

IFOAM - International federation of Organic Agriculture

IMTA - integrated multi-trophic systems in Greece

INRAE - National French Research Institute for Agriculture, Food, and Environment

Inter-Bio - Romanian Association of Organic Farmers

ITAB - French Organic Food and Farming Institute

KIS - Knowledge and Innovation System

LF - Danish Agriculture and Food Council (LF).

LFE - Local food experts in advisory service providers in Greece

LFI - Austrian Rural Institute for Further Training

LKNÖ - Chamber of Agriculture in Lower Austria

LVA GmbH - Lebensmittelversuchsanstalt

MATE - Hungarian University of Agricultural and Lifesciences

METABIO – INRAE established organic metaprogramme,

MNVH - Hungarian National Rural Network (Magyar Nemzeti Vidéki Hálózat)

NGO - Non-governmental Organisation

NSPA - (Italian) National Strategic Plan for Aquaculture

OAP - Organic Action Plan in Hungary

ÖMKI - Ökológiai Mezőgazdasági Kutató Intézet (Research Institute for Organic Agriculture)

ÖPUL - Austrian Rural Development Programmeme

PIF - Integrated Supply Chain Projects in Italy

RAS - recycled water systems in Greece

R&D – Research and Development

RDD - Rural Development Programmemes in Italy

RDP - Rural Development Programme

RMT - Réseau Mixte Technologique

SCAR/EU SCAR - Standing Committee on Agricultural Research

SEGES - Danish National Knowledge Centre for Agriculture

SME(s) - Small and Medium Enterprise

UAA – Utilised agricultural area

UMT - Unité Mixte Technologique

ZÖL - The Future Strategy for Organic Agriculture in Germany

Deliverable 1.1.: Assessment of the knowledge and innovation systems for organic agriculture, aquaculture and value chain actors.

Summary

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Work Package Leader:	Ingrid Jahrl (FIBL CH)
Task Leader	Nagy Gabriella Mária (ÖMKI)
Author(s):	Gabriella Mária Nagy (ÖMKI), Ingrid Jahrl (FiBL CH), Gerda Jónász (ÖMKI), Judit Fehér (ÖMKI), Nuri Nurlaila Setiawan (ÖMKI), Ursula Kretzschmar (FiBL CH) Susanne Padel (Thuenen), Attila Krall (ÖMKI)
Contributor(s):	Ambra de Simone (IFOAM Organics Europe), Stefano Orsini (IFOAM Organics Europe) Practice Partners: COISPA, Naturland, CIHEAM Bari, USH, ICOEL, LKNO, ITAB and AUH
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Executive Summary

Knowledge exchange between practitioners, research and policy is an established principle of all practice-oriented disciplines. In agriculture, such an approach of strengthening a knowledge-based network of individuals and organisations involved in generating, sharing, and applying agricultural knowledge and innovations is defined as Agricultural Knowledge and Innovation System (AKIS). Its development and support have been embedded in Strategic Plans of the Common Agricultural Policies (CAP SPs) for 2021-2027.

A well developed and functioning AKIS is important to reach the targets set in the European Union's new strategies, such as European Green Deal, the Farm-to-Fork Strategy, and the Biodiversity Strategy. These strategies aim at reaching at least 25% of the EU's agricultural land under organic farming by 2030 and significantly increasing organic aquaculture (hereafter referred to as "the organic F2F targets"). In 2021, the share of organic farmland was 9.9 % of total utilised agricultural area (UAA) in the EU-27 (EUROSTAT, 2023b). This implies that current organic area needs to triple within 11 years to meet the target. In 2019 organic aquaculture represented only 2% of total aquaculture production (based on tonnes live weight).

Although the Member States already stated their approaches in the National CAP SPs and in National Operational Programmes, the implementation methods and paths to reach these goals are still in question. The knowledge and innovation systems for organic will certainly play a key role for the achievement of the EU targets relating to organic farming. OrganicTargets4EU has examined the knowledge and innovation systems in seven focus countries for organic agriculture (Austria, Denmark, France, Germany, Greece, Hungary, Italy and Romania), three for organic aquaculture (Germany, Greece and Italy) and eight for organic processing and retail (Austria, Denmark, France, Germany, Greece, Hungary, Italy and Romania). This report describes the current state of play and the future actions to be taken to effectively upscale the knowledge and innovation systems in these countries.

The following key actions are identified:

(i) For **organic agriculture** the most important actions to be taken are the establishment of a systematic policy framework at national level in support of AKIS for organic, the provision of funding and capacities for research, knowledge creation and exchange among actors in AKIS and the food supply chain.

(ii) For **organic aquaculture**, an institutional start-up mechanism is needed to support this relatively young sector. This includes the development of a clear vision for the sector

supported by all value value chain actors, which can stand as a basis to the sectoral strategies, action plans and funding systems.

(iii) For **organic processing and retailing**, and more generally for a successful organic market development, it emerges the need for independent, qualified, and affordable support mechanisms. This refers to several levels: access to already existing knowledge and experts; involvement of public policy institutions facilitating support; research institutions to foster innovation; consolidation of cooperation among organisations, actors involved and regional clusters. This is especially important in countries with a less-developed support system.

1. Introduction

The Agricultural Knowledge and Innovation System (AKIS) has become a common term used at the national level when referring to the specific organisational and institutional arrangements to develop the agricultural sector. It is also used as a crucial concept for designing policies promoting innovation for sustainable agricultural development. AKIS is widely used in European policy documents, in the global literature on agricultural extension and it is adopted by international institutions (e.g., OECD, World Bank) (Sutherland et al., 2023).

The existing Common Agricultural Policy (CAP) strategic plans establish a connection between knowledge exchange among practitioners, research, and policy in the agricultural sector. However, given the growing challenges of ensuring sustainable food systems, food security, coherent supply chains, digitalization, and global transitions, a more comprehensive approach to the AKIS is required. The term "AKIS" refers to the network of individuals and organisations involved in generating, sharing, and applying agricultural knowledge and innovation. The CAP for the period 2021-2027 places increased importance on the embedded concept of AKIS. This involves building on the existing advisory services within the framework of national and cross-country levels of the CAP financial and policy structure. The aim is to establish a transparent network that facilitates the rapid flow of up-to-date knowledge and information among all stakeholders in the agricultural sector at national as well as European level.

The approach to AKIS is aligned with cross-cutting issues, which are supported by new strategies within the European Green Deal, such as the Farm-to-Fork (F2F) Strategy, and the EU Biodiversity Strategy. These strategies intend to mitigate climate change and promote healthy, sustainable living within the European continent. Within the new strategies, the EU has set the targets of at least 25% of the EU's agricultural land under organic farming and a significant increase in organic aquaculture by 2030. In 2021, the share of organic farmland was 9.6% of the UAA in the EU-27 (FiBL, 2023) . This implies

that the current organic area needs to triple within 11 years to meet the 25% target. Organic aquaculture currently represented 2% of total aquaculture production (based on tonnes live weight) in 2019 (EUROSTAT, 2023a). There is no concrete F2F target for organic aquaculture, but a similar triple growth rate as for farmland to a 5% share would require enormous efforts.

Reaching these ambitious goals demands a balanced upscaling of both production and consumption, implying a huge transformation in farm structures and supply chains. It also implies more than a million new people entering the organic sector who need access to organic knowledge. This transformation needs to be supported by ambitious research and innovation, strong advisory services, supportive processors and retailers, knowledge exchange and training opportunities for all organic operators and related professionals.
While the F2F targets provide a framework for boosting AKIS structures, there is a lack of knowledge about how such provisions are implemented in practice. The agricultural knowledge and innovation systems of EU countries have been analysed in several EU funded projects, such as in ProAKIS (2015)[1] or i2Connect (2021)[2]. These projects put their main emphasis on AKIS structures and functions of the prevailing conventional agricultural systems. Comprehensive knowledge about the organisational structure and functions of AKIS for organic in EU countries is lacking. OrganicTargets4EU fills this gap by analysing the organic knowledge and innovation systems in eight selected EU focus countries: Austria, Denmark, France, Germany, Greece, Hungary, Italy and Romania. Organic aquaculture knowledge exchange and supporting systems are analysed in Germany, Greece and Italy.

This report provides information on organic provisions and actors, their role as knowledge brokers and the information exchange infrastructure. It also attempts to draw a comprehensive picture of the new capacities needed for knowledge transfer as a basis for the further development of organic agriculture and aquaculture in Europe.

1.1. Defining AKIS

The prevailing understanding of AKIS is rooted in the concept of "Agricultural Knowledge and Information Systems" developed by Nils Röling in the 1980s, which emerged from a critique to the perspective of agricultural knowledge systems as linear approaches to knowledge transfer (Röling, 1988). The initial concept of AKIS was significantly shaped by an "infrastructure perspective," which focused on organisational frameworks and entities. This perspective revolved around the idea that knowledge production and

[1] ProAKIS https://430a.uni-hohenheim.de/pro-akis
[2] I2connect https://i2connect-h2020.eu/

exchange in the agricultural sector is based on a wide range of sources, including research, agricultural extension, education/training and support services. Today's approach is an evolution of this original concept: it strongly emphasises "innovation" and "process view", where innovation systems are seen as self-organising, growing networks of actors (Klerkx et al., 2012; Röling & Engel, 1991; Sutherland et al., 2023). In this approach, innovation linked to research is seen as a driver of economic development. Also, the novel perspective emphasises the importance of transdisciplinary knowledge and the involvement of different actors (e.g., farmers, extension services, the private sector, processors and retailers) within a "multi-actor approach" promoting research and innovation. This perspective has been strongly influenced since the 2010s by the EU's SCAR-AKIS working group. This group has been crucial in setting EU-level policies aimed at promoting knowledge exchange and innovation in the agricultural sector, particularly through the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-AGRI), launched in 2012 (Sutherland et al., 2023).

Different definitions of AKIS have emerged over time. In this study, the use of a consistent definition in the communication with the OrganicTargets4EU practice partners (partners with close stakeholder connections in the focus countries) and stakeholders is important. The AKIS working definition used by the project to guide data collection and analysis goes as follows: *"The Agricultural Knowledge and Innovation System (AKIS) can be defined as a system that links people and organisations to promote mutual learning, to generate, share and utilise agriculture-related technology, knowledge, and information within a country or a region. Components of an AKIS are diverse actors from the private, public and non-profit sectors relating to agriculture, it may include actors such as farmers, farm workers, agricultural educators, researchers, non-academic experts, public and independent private advisors, supply chain actors, and other actors in the agricultural sector"* (EU SCAR 2013).

1.2. Research questions

Based on the overall aim of the study, OrganicTargets4EU addresses the following research questions:

Research questions related to agricultural and aquacultural knowledge and innovation systems:

- What are the characteristics of the knowledge and innovation systems for organic agriculture and aquaculture in the selected focus countries?
- What are the lock-ins related to the knowledge and innovation systems of the organic sector and how to overcome them?

Research questions related to the knowledge and innovation system of retailers and processors:

- Which are the most important actors that are actively engaged in supporting the knowledge and innovation system for organic processing and retailing in the focus countries?
- What support is offered to processors and retailers and what methods are used?
- Is there a need for improvements?

2. Method and materials

The analysis of the knowledge and innovation systems in agriculture and the supply chain is primarily based on data and information gathered from experts and stakeholders in the focus countries. Practice partners as part of the OrganicTargets4EU consortium play a key role by conducting interviews with experts and by providing stakeholders' contacts for an online survey. This work is supported by guidelines[3] developed by the task team. The guidelines highlight the overall approach of the task, the criteria for expert and stakeholder recruitment. The approach goes as follows:

- Expert interviews: One to six interviews per focus country with experts and relevant stakeholders (e.g., knowledge providers, organic farmers' organisations, stakeholders of the organic aquaculture sector, certification bodies and policymakers) on characteristics of AKIS (Table 1).
- Online survey: The survey addresses experts and stakeholders in the focus countries (e.g., advisory services, expert/certification bodies, representatives of different organic farmers' associations), and generally aims to 20-30 stakeholder responses per country.
- AKIS stakeholder mapping: The interviews provide information and support the mapping of the AKIS.

The research methodology applied is described in detail below:

2.1. Expert interviews

Expert interviews are the most common format for data collection in qualitative research (Jamshed, 2014)(Prakash, 2018). The expert interviews in the focus countries are

[3] Available upon request

carried out according to semi-structured interview guidelines developed by ÖMKI and FiBL CH. Altogether three guidelines are developed for the different stakeholder groups and different sets of interviews:

I. Interviews on the knowledge and innovation systems (AKIS) for organic agriculture and aquaculture

The interviews aim to identify the AKIS organisational strengths, weaknesses, and lock-ins in the respective focus countries. Practice partners select one to six experts from each of the focus countries based on their experience and in-depth knowledge of AKIS for organic. The experts are selected from public and private educational and research organisations, advisory services, public authorities, certification bodies, organic farmers' organisations/associations, farmers' organisations/associations (including agricultural chambers), and where relevant, representatives of the organic aquaculture sector.

II. Interviews on the information and knowledge needs of organic processors and retailers

The aim of the interviews is to identify the current knowledge and information sources of processors and retailers on organic food and farming issues, as well as the strengths and weaknesses of the way knowledge provision is organised. The interviews also address the need for additional knowledge support. Practice partners select two to four organic processor and retailer companies per focus country. The companies interviewed include big and small companies, long-established businesses and start-ups.

III. Interviews on the information and knowledge provisions for organic processors and retailers

Additionally, FiBL CH carried out one to six interviews in the focus countries with knowledge providers, namely research institutes, advisers and certification bodies, as well as with representatives of associations for processing and retailing. The interviews aim to explore the scope of services provided, the strengths and weaknesses of knowledge provisions, and issues relating to cooperation and coordination.

Table 1 Interviews carried out in the focus countries

Countries	Interviews on AKIS for organic	Interviews on knowledge needs for organic processors and retailers	Interviews on knowledge provisions for organic processors and retailers
Agriculture			
Austria	4	2	2
Denmark	3	1	2
France	5	3	5
Germany	3	6	3
Italy	4	1	1
Hungary	6	3	2
Romania	4	2	3
Aquaculture			
Italy	2	-	-
Germany	5	-	-
Greece	4	2	-

In total, 78 mainly online interviews are conducted with experts from different kinds of affiliations in the eight focus countries between November 2022 and July 2023 (Table 1). The interviews are carried out by the practice partners in the respective national languages. The interviews carried out by FiBL CH are mainly done in English. The interviews are recorded, the anonymity of the interviewees and the confidentiality of data provided are guaranteed by a consent form signed by the interviewees. Interviews are summarised and reported in English. The summaries are analysed by using the programmeme ATLAS.ti for qualitative content analysis.

2.2. Online survey

For a comparative assessment and validation of the interview outcomes, a survey[4] is prepared, targeting stakeholders in the focus countries. Mostly single and multiple choice and some open-end survey questions are formulated including:

i) General questions on the organisation of AKIS for organic;
ii) More specific questions on organic advisory services, training and education, and the policy framework in support of the AKIS in the focus countries.

The survey is prepared in English and translated into national languages (Danish, French, German, Greek, Hungarian, Italian, Romanian) using DeepL, with an additional language check done by the project partners of the focus countries. The tool Lime survey is used as online platform for the questionnaire. The invitation to the survey is sent out via email to 541 potential participants, with a possibility to share with other relevant stakeholders. Between the 1st and the 23rd of March 2023, a total of 163 responses are received of which 91 are fully completed questionnaire and 72 partially completed. As the partially completed responses provide key information especially on aquaculture, these responses are kept in the samples (Figure 1).

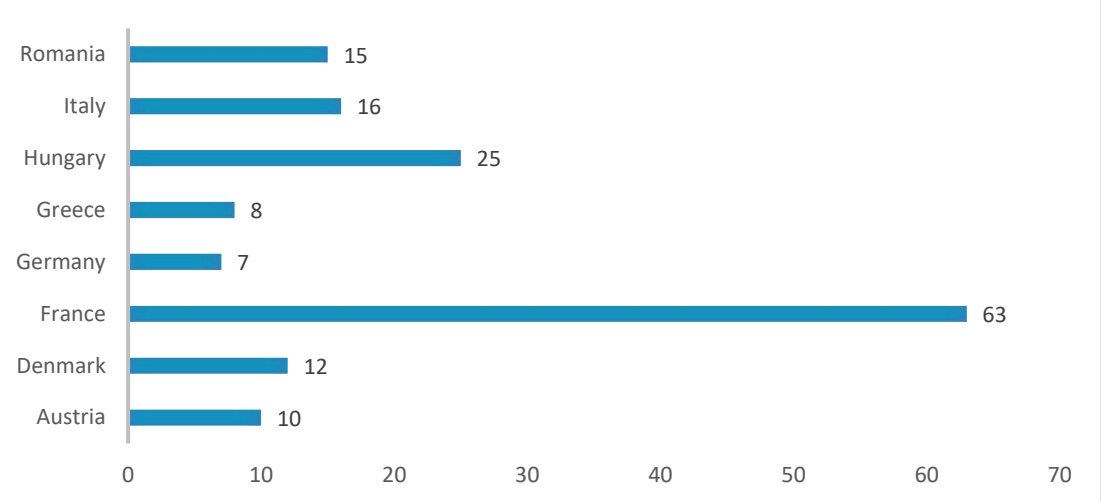

Figure 1 Respondents in the survey by country (n=156, 7 participants did not provide answers)

For the evaluation of the survey one of the most important criteria is the stakeholder role in the sector. Figure 2 highlights the stakeholders participating in the survey working in organic farming, while Figure 3 highlights the organic aquaculture stakeholders. Most organic farming participants are from organic farmers' associations and public

[4] Available upon request

educational and/or research institutions. Most organic aquaculture participants are from public/educational research institutions and certification bodies. The 'Other' category includes producers, pest risk assessment companies, private universities, cross-sectoral organisations, development consultants, direct marketing companies, secondary schools, and NGOs.

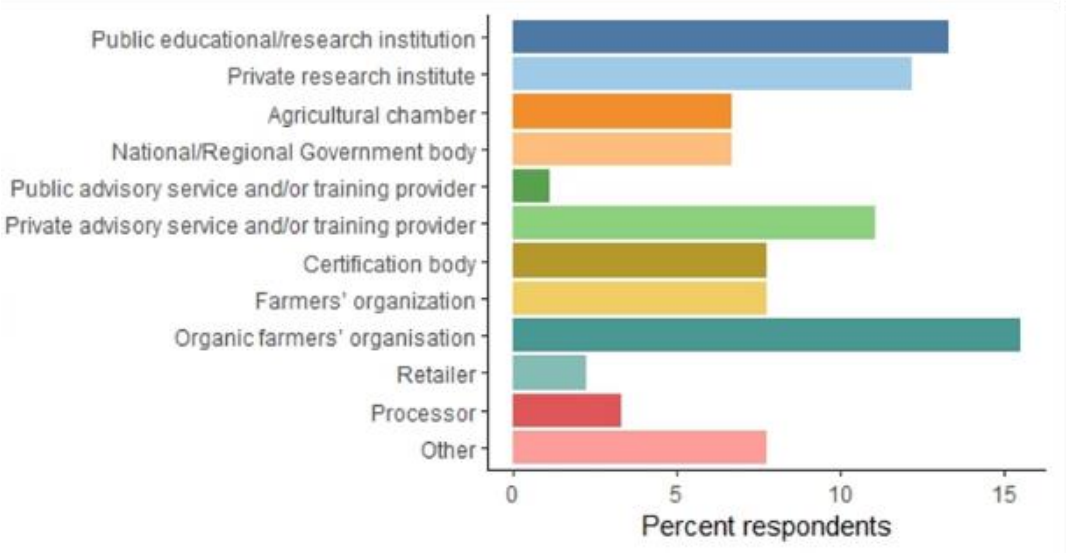

Figure 2 Participation ratio in the survey by profession in organic farming

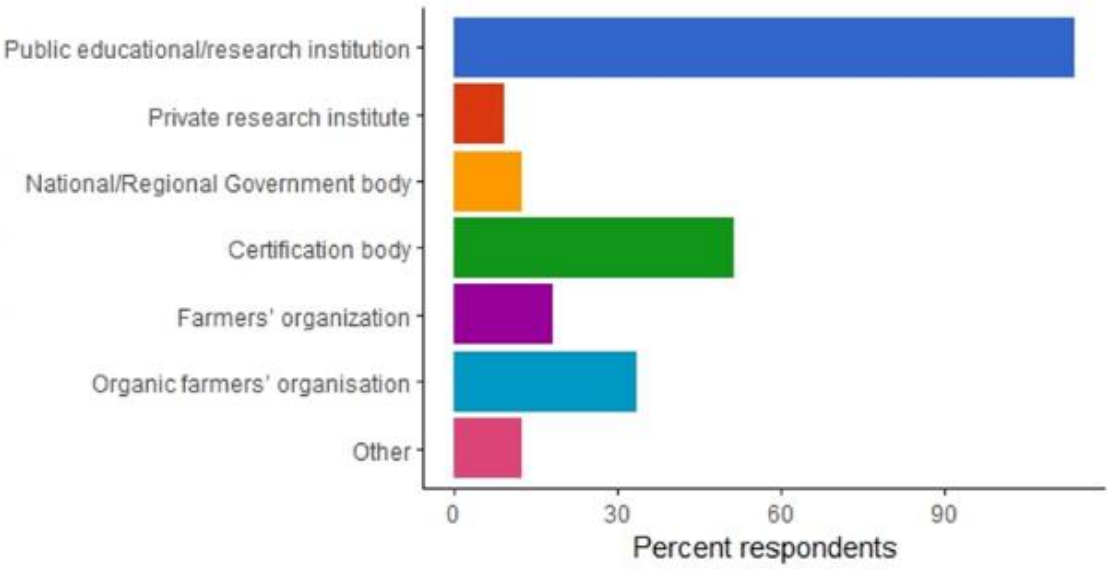

Figure 3 Participation ratio in the survey by profession in organic aquaculture

Raw survey data are extracted from Lime Survey and analysed in R version 4.2.2 (R Core Team, 2009) and visualizations are made using library ggplot2 (Wickham, 2009), Likert (Bryer & Speerschneider, 2016), and dendextend (Galili, 2015).

2.3. Stakeholder mapping

Stakeholder mapping is conducted as a basis for a better understanding of the organic provisions in AKIS in the respective focus countries. In the AKIS interviews, the selected experts are asked to fill in an Excel spreadsheet[5], to map the diversity of actors in AKIS for organic, as well as the connections and level of collaboration among different groups of actors. The exercise is a collaborative knowledge gathering with the aim of identifying all the existing connections among the actors. The stakeholder maps are not included in this report and are part of the country reports.

2.4. Country reports

Based on content analysis of the qualitative interviews, and the analysis of the survey, individual country reports are prepared for AKIS related to organic agriculture, organic aquaculture, and for case studies of organic processors and retailers. The country reports give a country-specific overview of the main strengths and weaknesses of the AKIS for organic, and list the main actors, their role and their potential for supporting AKIS for organic. The reports also give a detailed description of the status quo of the facilitating and supporting services provided by AKIS for organic in the respective countries, such as training and education, knowledge and innovation, advisory services, funding system and legal environment.

2.5. Limitations of the research

In this study practice partners interview and share the survey with experts and relevant stakeholders of the innovation and knowledge system, and supply chain actors of the organic farming and aquaculture. However, due to a relatively limited number of experts and stakeholders taking part in the interviews and the survey, the overview does not necessarily reflect the full picture of the sector.

[5] Available upon request

3. Assessment of the knowledge and innovation system for organic farming

This section of the report includes an assessment of the agricultural knowledge and innovation systems (AKIS) for organic farming. Based on the interviews and the survey, this section focusses on the organisational characteristics of the support systems for organic farmers and farmers in conversion. It covers polices and funding supporting AKIS, as well as the characteristics of their organisations and collaborations. Specific emphasis is given to the support provided in terms of knowledge and innovation, to the advisory services as well as to training and education. Assessments lead to conclusions and recommendations for further development of the organic provisions in AKIS.

Key facts and statistics on organic farming in the focus countries

The importance of organic farming according to the share of organically managed farmland and that of organic sales, varies greatly between the focus countries (Figure 4). Based on data from 2021, organic farming covered 15.6 million hectares of agricultural land in the EU, equivalent to 9.6 % of the total utilised agricultural area (UAA). As regards the ratio to land area, Austria takes the lead with 26.5% of land being organic area, followed by Italy (16.7%), Denmark (11.4%), Germany (10,8%) and France (9.6%). The lowest share of organic area among the focus countries is in Hungary (5.9%) and Romania (4.3%), even though that both countries have increased their share of organic farmland by more than 100% in the last decade (FiBL, 2023). France has now a well-established organic sector, but similarly to Hungary and Romania, the share has grown significantly in the last two decades.

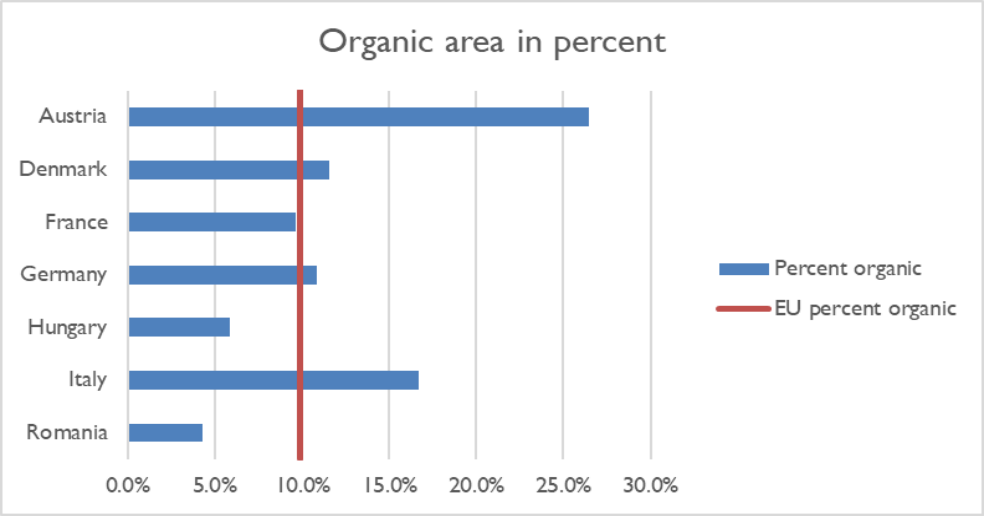

Figure 4 Share of organic area in the focus countries and EU average (Source: statistics.fibl.org)

A very similar picture emerges for the share of organic retail sales. Denmark takes the lead with 13%, followed by Austria with 11.6% of organic sales. Germany (7%) and France (6.6%) show shares, still above the EU average (4.7%). Hungary (0.3%) and Romania (0.2%) are the lowest in terms of share of organic retail sales (Figure 5) (FiBL, 2023).

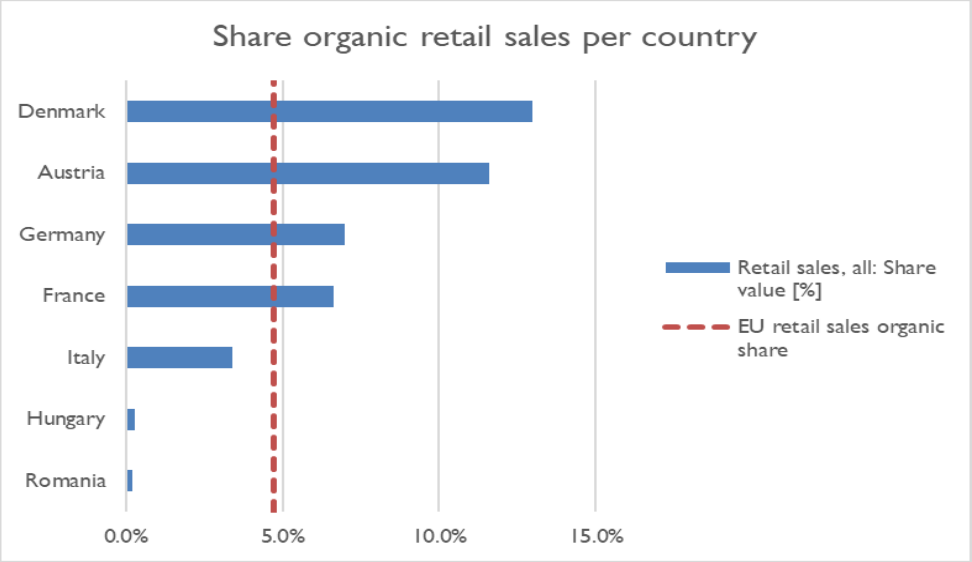

Figure 5 Share of organic retail sales in the focus countries and EU average (Source: https://statistics.fibl.org)

3.1. Summaries of AKIS for organic farming in each focus country

Austria

Organic sector development

The organic sector in Austria holds a prominent position within the country's agricultural industry. In 2021, the organic land and land under conversion was 26.5% of the utilized agricultural area (UAA) (FiBL, 2023). The development of the organic sector in Austria has been fuelled both by early organic subsidies in 1992-1995 and by the consumer demand for organic products, that are accessible to a wide range of consumers in different retail chains. The organic market accounts for 11.6% of the total retail food market. In Austria, organic farmland grew by more than 7000% between 1985 and 2021. However, the growth rate between 2001 and 2021 was lower compared to other focus countries (FiBL, 2023). The two main land use types in organic agriculture are permanent grasslands (57.7%) and arable land (40.5%) (EUROSTAT, 2023b).

Policy background of AKIS relevant to organic sector

In Austria, policy support and government driven development of advisory services are of great importance. The Ministry of Agriculture, Forestry, Regions and Water Management financially and institutionally supports compulsory advanced training programmes on organic farming and conversion under the Austrian Rural Development Programmeme (ÖPUL 2014-2020), recently replaced by the CAP Strategic Plan (2023-2027). The Bio Aktionsprogrammem (2023 – ongoing) provides additional funding for education and advisory services and calls for organic education projects.

The Austrian CAP Strategic Plan (SP) main targets are modernization, improvement, and development of AKIS and digitalization. To reach these targets the most important measures are: improving and further developing the structure and functionality of the national AKIS; strengthen the knowledge base; increase practical relevance and target-group-oriented content; establish new working groups to provide platform to day-to-day sectoral discussion on burning issues; establish cross-sectoral and cross-industry innovation in the local and regional context; support international research, knowledge exchange and cooperation; support internal cooperation among actors in AKIS.

To address these measures, the CAP SP foresees a key role for the Chamber of Agriculture ARGE Bioberatung and the Organic Farmers' Association BIO AUSTRIA in the national AKIS system in cooperation with other institutional actors e.g., the federal authority system.

Knowledge creation research and innovation

The organisation of the AKIS in Austria may be best described as a well-established network connecting farmers, researchers, extension services, policymakers, or industry representatives. The primary objective of AKIS in Austria is to promote knowledge exchange, innovation, and sustainable practices across the agricultural sector, including organic agriculture. LEADER programmes as well as EIP-Agri projects have been key to foster knowledge and innovation in organic farming. There is further potential seen in developing research and practice cooperation, for example by organising demonstrations on technologically advanced farms to spotlight innovative practices.

Education and training

Public educational and (vocational) training programmes on organic agriculture are coordinated at a national level, especially on regulatory aspects and on-farm processing of organic farming. There hardly exists capacity building for organic advisors and trainers.

Training programmes relevant for organic farmers focusing on-farm processing are available. Organic associations and the Rural Training Institute (LFI) are the most important providers for training courses for organic producers. Nearly all courses for organic producers are subsidized (at least 50%) under the regime of the Austrian Rural Development Programme. However, the experts interviewed report a lack of public funding for education courses for organic farmers. There is a lack of teachers' interest or understanding for organic farming, reflects a limited number of teachers with comprehensive knowledge of organic farming. A whole organic track for agricultural education and qualification in organic production at A-level is advisable according to the experts.

Advice / consultancy

In Austria, organic farming advice is provided by (organic) farming associations as well as the Chamber of Agriculture 'ARGE Bioberatung'. Through close cooperation with the latter, the Organic Farmers' Association Bio Austria is able to draw on national funds for extension services and consulting since 2017. The collaboration also builds the foundation for advisory services across all regions in Austria. Still funding for extension services is considered not to be sufficient and comes with high administration requirements. Exchange with research organisations is not sufficient either, and advisors often lack time (because of bureaucratic duties) in their work with organic clients.

Conclusion

The country's commitment to sustainable practices, consumer demand for organic products and the presence of political support have been the main driving forces for the expansion of the organic sector in Austria. This led to organic farming becoming a significant player in the country's agricultural sector. The AKIS has a key-role in supporting this growth. The strength of AKIS for organic lies in the experienced and well-established network of actors, but there are weaknesses in relation to coordination, strategic focus, and specialised support. Overcoming these challenges would require targeted funding, improved coordination, and stronger focus on farmers' education, advisors' training, and innovative integration of research and practice.

Denmark

Organic sector development

The organic market in Denmark is the largest in the world, with organic food making up roughly 13% of the total retail food market in 2020 (FiBL, 2023). In this mainly consumer

demand-driven market, the main products are dairy products, eggs, oatmeal, wheat flour and carrots. Imports play an important role to satisfy the growing demand for organic products in the country. Organic exports from Denmark accounted for approximately 15% of all Danish organic sales in 2021 (Bech-Larsen et al., 2023). The relevant product groups for exports have hardly changed over the years with dairy products and eggs standing out, followed by (pig) meat and vegetables. Almost half of the exports go to Germany, followed by Sweden, and, at a certain distance, China, the Netherlands and France. Over the past five years, organic exports have doubled to almost EUR 400 million (Danish Agriculture & Food Council & Organic Denmark and Food Nation, 2023). In 2021, the organic land area and area under conversion was 303.093 ha, which accounts for 11.5% of the utilized agricultural area (UAA) (FiBL, 2023). The organic area expanded between 2001 and 2021 by 80%. The two main land use types in organic agriculture are arable land (83%) and permanent grassland (15.7%) (EUROSTAT, 2023b). The standard and well-respected labelling system supporting the organic market development in Denmark rests in a unique and broadly trusted approach of the Danish state overseeing both regulation and inspection. More than 95% of the Danish population knows and trusts the Danish organic label (red crown in the Øko-symbol (Landbrug & Vodevarer, 2017).

Policy background of AKIS relevant to organic sector

Denmark is one of the first countries to follow the organic standard with the introduction of an organic labelling system, organic rules and public inspections. This created a strong, trusted national logo, that supported the already existing consumer interest. The first Organic Action Plan (OAP) was launched in 1995. Back in that time, this innovative political action was a driving force for new knowledge creation and the overall development of the organic sector in Denmark. However, there is no strategic document that specifically supports the development of AKIS for organic, coupled with a lack of funds to invest directly in AKIS. Instead, the importance of knowledge and innovation is mentioned in several country-level strategic policy papers, including the new CAP Strategic Plan where the main objective is digitalization. The CAP SP aims to maintain the already existing AKIS and continue the tradition of participatory and top-down mix of approaches supporting operations of AKIS, while not separating AKIS for organic from the general AKIS structure.

Knowledge creation, research and innovation

The research structure behind the organic sector is mostly practice-oriented, characterised by a good flow of knowledge and collaboration among AKIS actors in applied research projects. The main hubs for knowledge creation and innovation in organic farming in Denmark are ICOEL (Innovation Centre for Organic Farming), Organic

Denmark (Økologisk Landsforening; farmer owned, mostly strategic and political), SEGES Innovation (R&D for conventional farming), and advisory service providers. The international Centre for Research in Organic Food Systems (ICROFS) at Aarhus University seeks to improve the knowledge exchange between research and extension. Freely accessible research and information on e.g., AKIS actors' website are important e-knowledge sources for the organic sector in Denmark.

Education and training

Aarhus University offers a two-year MSc programme in organic agriculture and food systems. Efforts have been made to develop a curriculum that focuses on organic farming and to provide training programmes and courses on organic farming at the agricultural colleges (Landbrugsskolerne), requested by the organic farming associations, and supported by the Agriculture and Food Council (LF). ICOEL organises education programmes for farmers focusing on organic farming. Unlike public education in general, most training programmes in agriculture are not free of charge. Still, a considerable amount of information is freely available online.

Advice / consultancy

Advisory service providers are a key link between farmers and other AKIS actors. All conventional advisory organisations offer services in organic farming as a separate but fully integrated part of their portfolio. Although consultants are available throughout the country, in some regions they do not prioritize issues of organic conversion in their services. Besides the technical aspects of organic farming, financial advisory, accounting, and legal advice for primary production are also covered. Larger service providers also give support in direct marketing, whereas others are specialised in supporting small farms. Different target groups of extension services, e.g., small-scale farmers or new generations of independent farmers without ties to farmer-owned companies are addressed through advice and support (e.g., market information, market development, marketing, labelling etc.). The main bottleneck of the organic advisory system is the lack of public funding behind.

Conclusion

Denmark's organic sector showcases a well-structured AKIS with strong collaboration and proactive farmer engagement as well as an outstanding collection of data and literature freely available for farmers. However, challenges remain in the areas of funding and knowledge exchange between research and extension. A targeted strategic approach, improved funding mechanisms, and enhanced integration could further

strengthen Denmark's already effectively functioning organic knowledge and innovation system.

Germany

Organic sector development

Germany has a long tradition of organic farming, though the organic land area accounts for only around 11% of the utilized agricultural area (UAA), which is just slightly above the EU average (FiBL, 2023). Organic agriculture has remarkably grown in Germany between 2001 and 2021, with the organic area increasing by 183%. Regarding its total value, the organic market is the largest in Europe, but Germany lags behind other countries in terms of share of retail sales (7% in 2021 compared to 13% in Denmark). Germany has a target of 30% organic area by 2030.

The two main land use types in organic agriculture are arable land (47,6%) and permanent grasslands (50.8%) (EUROSTAT, 2023b). As seen in many other European countries, organic competes with other quality-related labels, traditional specialities, or geographical indications, which is described as a hampering factor for further market development.

Policy background of AKIS relevant to the organic sector

The AKIS system in Germany integrates a wide range of actors including regional (Bundesland) and federal public administrations, private industries, agricultural organisations and NGOs. While the federal government mainly plays a coordination role, responsibility for most AKIS activities lies with the 16 German regions.

The Future Strategy for Organic Agriculture (ZÖL), first developed in 2017 and similar to a German Action Plan for organic farming, is currently being updated in consultation with the sector. Since 2001, there has been a federal R&D programmeme in the field of organic farming, the 'Bundesprogrammem Ökologischer Landbau' (BÖL). This programmeme puts a great emphasis on knowledge exchange, but its funding has varied greatly over time. Similarly, EIP-AGRI is implemented in the whole country since 2014 (with regional differences in thematic focus and operation groups supported). Of more than 300 operation groups funded so far, about 16% address topics related to organic farming. The CAP SP does not specifically mention organic farming in the AKIS section, apart from the goal to improve networking among AKIS stakeholders, both between regions and internationally.

Knowledge creation, research and innovation

The governance, funding and implementation of public agricultural research is shared between the federal government and the regions. The Federal Ministry for Food and Agriculture (BMEL supported by the administrative body BLE) is responsible for the federal (departmental) research institutions and funding of research programmes as well as the implementation of a cross-cutting strategy for research and innovation. As part of research accompanying innovation, a network of different stakeholders in animal welfare has been set up, and a similar network is planned for organic farming. The regions are responsible for research in the universities and their own research stations.

The federal research programme for organic farming BÖL is practice-oriented and focuses on knowledge exchange between research and practice. The calls for proposals consider the critical needs of the organic sector, although improvements are clearly possible. The BÖL projects are considered as important for knowledge transfer between research and practice. The EIP-AGRI measure of the CAP has been implemented across the country since 2014 (with regional differences in operational groups supported and thematic focus). Around 16% of the more than 300 operational groups funded so far have addressed topics relating to organic farming.

The main actors in agricultural research are universities, federal and regional government research institutes, other non-university and private research institutes, and the Chambers of Agriculture. All these actors are involved to some extent in organic farming research. The most important knowledge centres are the federal public research institutes (e.g., Thünen Institute) and universities, although a few private institutions also play an important role, such as Naturland.

The actors and themes are coordinated by the Deutsche Agrarforschungsallianz (DAFA). Its thematic forum on organic food and farming and the organic research strategy that has developed have been taken into account in the development of the German Organic Farming Action Plan 2023 (ZÖL). There are easily accessible information hubs for farmers and other stakeholders, such as Ökolandbau.de. Through the BÖL and EIP-AGRI programmemes, the transfer of knowledge between research and practice is considered effective. However, there are gaps in funding for research and innovation to meet the knowledge needs of the organic sector.

Education and training

Education and training are the domain of the regions, whilst the federal government has limited responsibility for professional education. The dual vocational training system combines farm-based training with regular attendance at vocational schools (Berufsschulen), but the provision for organic agriculture is not well developed. Advanced training takes place in the form of 1 or 2-year courses at technical colleges

(Fachschulen) leading either to a certificate as “Meister” or as a technician (Techniker). There are also a few scattered technical colleges on organic agriculture (e.g.: Landshut, Weilheim and Kleve). Higher education in agriculture is offered by 22 universities and universities of applied sciences. There are targeted programmes with a clear focus on organic farming (e.g., the University of Kassel and the HNE Eberswalde), but most of the other universities offer such modules.

The network of Organic Demonstration Farms is targeting farmers and the general public. Several players, both public and private, offer a range of short training courses related to organic farming and specific topics. This includes one-day orientation and two-day conversion seminars, research-based knowledge exchange (KE) events of the federal programme BÖL, and introductory courses for farmers provided by the farmers associations. The events support both formal and informal (e.g., peer-to-peer) learning and include publicly funded training offers.

Advice / consultancy

Providing advice for farmers in Germany is the responsibility of the regions, whereby public and private systems co-exist, funded either by CAP or other funding streams. In Central and Southern Germany, the main provision happens through public / governmental advisory services; in the North-West through Chambers of Agriculture and advisory rings; in the East mainly through private providers.

The provision of organic advisory services uses broadly the same structures; but organic farmers organisations also provide advice. An evaluation for BMEL reported good availability for organic nationwide, but with a structural deficit in the East. The focus is often on technical issues. Connections with research exist but could be improved and there is a lack of researchers on preparing knowledge for practice and on training of advisors. Funding in the various structures may not be sufficient to cover needs in line with growth targets.

Conclusion

With a long tradition in organic farming, the provisions for organic in AKIS are also well established, particularly in relation to advice with offers from the organic sector organisations as well as public bodies, and a dedicated research programme since 2001. The main weakness relates to fragmentation and a lack of national coordination, particular regarding the link between knowledge creation, advice, vocational training and education for farmers and other organic operators. Whilst the German AKIS is considered one of the strongest in Europe, there are problems with fragmentation and not well functioning knowledge flows between regions and between actors.

Italy

Organic sector development

The organic sector in Italy had a significant, but uneven growth in the last decades. A rapid expansion phase occurred from 1990 to 2000, followed by a period of stagnation between 2000 and 2014. Subsequently, there was a return to moderate growth until 2021. Notably, the organic land management expanded by 77% between 2001 and 2021. In 2021, the overall organic and land area under conversion to organic was 16,7% of the utilized agricultural area (UAA), which is the second highest share after Austria (FiBL, 2023).

In 2020, the expansion of the organic market reached a 1712 million EUR revenue, represented mainly by packaged food and beverages (Global Organic Trade Guide, 2023). The total share of organic food sales in Italian food expenditure was 4% of total food sales. The geographical distribution shows that 51% of the organically cultivated land are in four regions: Sicily, Puglia, Calabria and Emilia-Romagna (SINAB, 2020). The two main land use types in organic agriculture are arable land (48.5%) and permanent grassland (27.9%), with a high share of permanent crops (23.6%) compared to the other focus countries (EUROSTAT, 2023b).

Policy background of AKIS relevant to the organic sector

An AKIS to support the organic sector in Italy is dealt with under both the Italian National Action Plan for Organic Farming and Products (2005, renewed in 2008) as well as in the 2014-2020 CAP framework. The new CAP Strategic Plan aims to:

- Support cooperation among already existing AKIS actors, especially among the independent regions;
- Support active cooperation between research and consulting facilities;
- Set new coordination bodies to support AKIS in all provinces;
- Strengthen the research and knowledge creation through research funding and the actors' involvement in practice-oriented research;
- Review the bureaucratic system and ease farmers' conversion to organic;
- Continue data collection and monitoring schemes;
- Support risk management especially of newly introduced diseases.

Knowledge creation, research and innovation

Orientation of organic farming research towards practical needs is the key idea behind recent multiple, but not always systematic, co-constructive approaches to research in Italy. Knowledge transfer between research and practice, on the other hand, works well in these cases and knowledge exchange between research and advisory services has improved significantly, especially through programmes like the EIP-AGRI, PIF (Integrated Supply Chain Projects), and RDD (Rural Development Programmes). In the absence of a national e-infrastructure, several platforms provide knowledge exchange with a limited scope and for a specific audience. The lack of continuity of the efforts and a shared vision for the future of the sector undermines effective collaboration on research and innovation in the Italian AKIS.

Education and training

The most important bottleneck to training and education for organic farming is the lack of availability of constant and permanent public educational and vocational programmes on organic farming. Organic farming only occasionally appears in the curricula of undergraduate and post-graduate courses. Training programmes available on organic farming are sporadic, lacking innovative approaches to attract both students' and agricultural producers' attention to organic farming.

In recent years, some universities have introduced courses on sustainable agriculture (e.g., the University of Perugia, and the University of Milan) that included organic farming practices and principles, and others have introduced a specific course on organic agriculture production (e.g., University of Padova on organic vegetable production), but these are not permanent.

Initiatives for technical training and updating advisors and organic inspectors are usually initiated and implemented by third sector operators (e.g., Federbio). Among such initiatives, it is worth mentioning the 'Academia Bio' developed by Federbio (Federazione Italian agricoltura biologica e biodinamica), which provides specialised training programmes, coaching and technical assistance in classroom setting or on-farm to farmers, processors and consultants. It operates in close collaboration with training centres, universities, agri-food companies, and associations.

Advice / consultancy

Very few advisory bodies provide assistance to organic farmers, especially when it comes to specific services for small-scale organic farmers. The availability of organic advisory services depends on competent and dedicated people and includes production-oriented technical assistance as well as support for sales and direct marketing.

The organic advisory services available are mainly provided by private bodies. However, there are also public support services, depending on the availability of regional funds and political support.

Bottlenecks include fragmentation of the system, lack of dialogue among actors, and lack of a common and systemic way of thinking. The provision of advisory services is still not multidisciplinary, as there is insufficient interaction and dialogue between research actors and those responsible for knowledge dissemination. Advisors tend to focus on rather narrow areas, limiting their attention to certain crops or themes (e.g., soil fertility, plant disease) while failing to provide more comprehensive support. Efforts at regional levels are unable to influence other regions due to the lack of collaboration with inter-regional AKIS actors. There is the need for a better national and interregional cooperation.

Conclusion

The AKIS for the organic sector in Italy can be described as a thematic sub-system of the main AKIS. AKIS actors engage in organic agriculture through research, innovation, education, training and consultancy according to a regional setting, with fragmentation throughout the country, and relying on local, regional and national actors with their local branches. The work carried out by national and local networks only partially compensates for the lack of public support (financial and human), with differences in quality between regions and production sectors. However, considering the multi-faceted and integrated nature of organic agriculture, Italy's organic provisions in AKIS are too fragmented and unstructured to ensure an effective knowledge exchange among AKIS actors across regions and sectors. There are no national funds specifically allocated to the tasks to be performed by AKIS for organic. Even though the capacities and tools to provide more comprehensive support are available for several AKIS actors, they are not used in an organised way to provide well-structured, integrated support. There are shortcomings in the management and overall logistics of support services.

France

Organic sector development

The organic sector in France had a remarkable expansion in the last two decades. Between 2001 and 2021, organic land management expanded with 561% (FiBL, 2023). In 2021, the organic and under conversion area was 9.6% of the utilized agricultural area (UAA) of the country. In 2019, France had the second largest European organic market with 11.9 billion EUR revenue and a significant export market generating 826 million euros (Taste France for Business, 2023)The domestic organic food market accounts for

6.6% of the total retail food market. While organic eggs make up an important share of domestic food retails, the products with the strongest growth are processed foods, including frozen foods, beer, dairy products, canned and packaged foods, fruit juice and non-alcoholic beverages. The two main land use types in organic agriculture are arable land (57.3%) and permanent grasslands (34.7%) (EUROSTAT, 2023b). Regions with the greatest area under organic farming in 2019 were: Pays de la Loire, Bourgogne, Nouvelle Aquitaine, Auvergne Rhône Alpes, Occitanie.

Policy background of AKIS relevant to the organic sector

The French organic action plan (Ambition Bio Plan 2013-2017) aimed to double the organic land share of the country in five years with a focus set on coordinating interactions between the relevant AKIS actors. Between 2010 and 2020, 12 million EUR have been granted to R&D projects in organic farming under the "Innovation and Partnership" call for proposals of CASDAR (Public funds from the Ministry of Agriculture). The subsequent organic action plan (Ambition Bio Plan 2018-2022) set a target of achieving a 15% of organic land share with a budget of 1.1 billion EUR. This was supported by a reinforcement of funds, the "Avenir Bio" structuring fund managed by Agence Bio, which has been gradually increased from four to eight million EUR per year. While 9.7% organic land share was achieved in 2021, the goal for 2027 is 18% organic share. This shall be supported by the 2019-2025 Strategic Plan and the 2021-2025 “Contract of objectives and performance of the network” of the Chambers of Agriculture, which identified the challenges to support organic farmers. The new CAP SP highlights the importance of cooperation among actors, setting several tasks on already existing sectoral bodies to accelerate the implementation of the tasks omitted from the previous CAP period.

Knowledge creation, research and innovation

The research culture in France is participatory, demand- and practice-oriented. There is a long-standing history of active NGOs and a civil society with a well-established “bottom-up” dynamic, which is politically supported through diverse programmes and networks. However, the actors setting R&D goals are broadly disconnected from those providing advisory services. While too little is known about research needs in the field, not much knowledge is produced that can support trainers and extension service providers. A nationwide coordination structure with the right mechanisms could improve that (e.g., CSAB (Organic Agriculture Scientific National Committee), the Synergy Programme, Metabio). The public research institute INRAE is considered as an important knowledge hub together with the private research institute ITAB, a transversal technical institute dedicated to knowledge development. Networks such as GIS (Groupement d’Intérêt Scientifique), RMT (Réseau Mixte Technologique), UMT (Unité Mixte

Technologique) facilitate knowledge exchange between researchers, advisors and applied research programmes such as CASDAR, which requires partnerships between research, development and training. The work of AKIS actors should also be more structured and coordinated at the regional level.

Events such as Tech'n Bio organised by the Chamber of Agriculture, which has a large outreach and influence on producers, provide opportunities for knowledge exchange and further cooperation between organic and non-organic producers. Experts highlight the necessity for more of such events to foster knowledge exchange. The network of organic farmers' groups (FNAB network with regional GABs) is organising events such as "La Terre est notre métier" for exchange between farmers, advisors, researchers on innovations in organic farming.

There are online knowledge-sharing platforms, but these platforms are not connected to each other. Besides the promotion of e-learning, support should be provided to allow the establishment of structured spaces for knowledge exchange, such as Tech'N Bio. Overall, peer-to-peer exchanges between farmers and between advisors should be encouraged, preferably mediated by experts (e.g.: there are well functioning exchange groups, the organic sections of AACC, CETA, etc.).

Education and training

Agricultural training - be it vocational or continuing education - is key for orienting agriculture towards organic at least since 2008. Already in 2021 there were 130 training courses on organic farming (compared to 40 in 2010). The increased number of vocational training prepares young people to choose this pathway after high school. In fact, there are more students in technical agricultural training programmes (BTS studies, age 16-20) than in higher education programmes in agronomy. However, teachers' knowledge and attitude towards organic farming agricultural high schools remains a bottleneck.

In addition, by 2025 the agricultural chambers aim at supporting at least 40,000 established farmers through adult training for organic conversion. Fomabio, a recognized network of public and private agricultural education on organic farming, has only very limited human resources and not always up to date with the challenges of organic producers. Different training schemes on organic agriculture also exist for advisors, such as RESOLIA for advisors of agricultural Chamber.

Advice / consultancy

Broadly speaking, despite regional differences, the advisory services in France mostly meet the specific knowledge needs of small-scale organic farmers. Although the number of advisors for organic farming has increased in France, the lack of staff and insufficient

expertise remains an issue for organic advisory services. The lack of funds to cover extension services adds to the rivalry between advisory structures (such as GABs and CDAs) in some regions. Overall, however, the chronic underfinancing disincentivizes actors to devote time and effort to training, knowledge sharing, or facilitation.

Conclusion

The French AKIS for organic has made significant progress in supporting the rapid growth of the organic sector in the last decade. The main strengths of the AKIS for organic lies in the interdisciplinary and cross-cutting institutional structure and the well-established bottom-up collaboration of actors, including conventional farmers, but also the notable financial and technical support by the Chamber of Agriculture. Still, there are challenges to overcome in terms of funding allocation among AKIS actors and for the sector in general; foster coordination especially on ministerial level; establishment of structured online spaces for knowledge exchange; enhancing the effectiveness of knowledge sharing and advisory services; and especially reaching higher political levels. Also, there should be more structured coordination efforts for the work of AKIS actors at the regional level.

Hungary

Organic sector development

The organic sector in Hungary has expanded rapidly over the last two decades. Between 2001 and 2021, the area under organic farming increased by 271%; by 2021, the area fully converted and under conversion to organic farming has reached 5,9% of the utilized agricultural area (UAA) (FiBL, 2023). The two main land use types in organic agriculture are permanent grasslands (61.2%) and arable land (34.1%) (EUROSTAT, 2023b). The key permanent crops are orchards (apples, cherries, plums), nuts, grapes and berries (Organic Europe, 2023). The organic sector in Hungary is highly export-oriented, with app. 85% of the organic production going into export. Exports are mainly raw materials or products with low added value (Organic Europe, 2023). The domestic organic food market accounts for app. 0.3% of the total retail sales (FiBL, 2023).

Policy background of AKIS relevant to the organic sector

The Organic Action Plan (2014-2020) aimed to develop AKIS. The renewed National Action Plan for the Development of Organic Farming (2022) emphasises the need to improve advisory services for organic farming by the Chamber of Agriculture. In line with this policy goal, the Chamber of Agriculture aims to build a specialised advisory network

by 2024 and to publish sector-specific technical guidelines for farmers to facilitate a successful conversion to organic farming. A task force on organic R&D was established in early 2023 by the Ministry of Agriculture to improve R&D in organics and to coordinate relevant research of AKIS actors. In the absence of a comprehensive policy strategy, sporadic activities, like project grants (e.g., the MNVH, EIP Agri Operational Groups) support AKIS development.

Knowledge creation, research and innovation

ÖMKi has a leading role in organic research and knowledge exchange together with few dedicated researchers working at different university departments or public research institutes, and a number of innovative organic farmers. At ÖMKi, co-creation, living Labs and on-farm experiments are in practice in addition to traditionally structured scientific work. Research activities are funded by local and/or international projects, which usually have a duration of 2–5-years. The experts interviewed highlight that small and medium-scale organic farmers are usually more open to research collaboration, while larger producers have the financial means to involve (often foreign) advisors in case they wish to overcome specific technological challenges. Producers of organic plant protection materials (e.g., Biocont Ltd.) also have advisory services and set up on-site trials to measure the effectiveness of their products and to develop them further.

Education and training

Different training programmes are available on organic farming at the different levels of the education system often for free or at low costs. More complex training programmes by for-profit and not-for-profit organisations come with an attendance fee. While there is no 'formal' qualification for converting farmers, there are shorter courses on organic farming topics offered outside the formal higher education system. Workshops and training on organic farming are usually organised as part of international research projects.

There is one MSc programme on organic farming (at MATE University of Life Sciences). However, no BSc-level programme allows to embark on the matter, while organic farming generally remains underrepresented in a broad portfolio of sustainability-related courses.

Advice / consultancy

The advisory network planned by the Chamber of Agriculture for 2024 should make advisory services available to all farmers. However, there are few staff specialised in organic farming, and relevant professional training to help advisors understand the differences between organic and conventional methods has not been started, which is

hampering farmers' transition. Advice is currently limited to administrative assistance on the application process for organic subsidies. More complex and production-related technical assistance relies mainly on the expertise of international input providers and grain traders. As they are not independent consultants, their activities are not subsidised. Accordingly, farmers tend to turn directly to certification bodies to find out the basic compliance requirements. Although they are not formally independent either, their informal advice meets farmers' knowledge needs. A few international organic advisors are also active in Hungary at larger scale operations, who can afford the extension service costs.

Conclusion

Hungarian organic production needs more practice-oriented research, more dissemination work, backed up by local scientific evidence. Efforts should be made to increase consumer awareness and create a stable and growing organic sector and a stronger internal market. Cooperation and better communication between organic actors (producers, traders, umbrella organisations, certifiers and research institutions) is essential. AKIS for organic is in need for more central coordination efforts and dedicated funding.

Romania

Organic sector development

The organic sector in Romania has grown significantly over the last two decades. Between 2001 and 2021, the organic land area expanded by 1916% (EUROSTAT, 2023b), reaching 4.3% of the utilized agricultural area (UAA) in 2021. The two main land use type in organic agriculture are arable land (59,24%) and permanent grasslands (37,09%) (EUROSTAT, 2023b). The main arable crop groups are cereals, green fodder and oilseeds. The main permanent crops are fruits, grapes and berries (Organic Europe, 2023). The domestic share of organic retail sales accounts for 0.2% (FiBL, 2023). The organic sector in Romania is highly dependent on export to Western-Europe and Middle East (Organic Europe).

Policy background of AKIS relevant to the organic sector

Legislation supporting the organic sector was introduced in the early 2000s, following the EU legislative framework. The first set of standards were introduced in 2004, along with the first subsidy system (Organic Europe, 2023). The new CAP SP includes the specific objective of strengthening the position of the organic actors in the AKIS.

However, in the absence of capacity building for key planning actors, the SP does not include critical details on national priorities and implementation.

Knowledge creation, research and innovation

Although agricultural research in Romania is only recently becoming participatory, it is already generally demand-driven and responsive to the information needs of organic farmers. However, knowledge transfer in a post-socialist country principally suffers from a fundamental lack of trust between actors. Experience with structured dialogue is scarce and the capacities of AKIS actors in organic agriculture are still broadly insufficient. Knowledge exchange works particularly well where clusters provide an enabling environment for networking and cooperation. The main knowledge hubs are the InterBio consortium with four clusters active in different regions and knowledge centres, some university departments, and some public research institutes.

In the absence of a centralized digital information platform for organic farmers, local e-infrastructures developed for the clusters, business and export purposes, technology transfer and R&D can fill this gap. Knowledge creation and efforts in information dissemination are still mainly dependent on EU funding and programmes. National R&D programmes and private organisations or investors provide complementary funding.

Education and training

There are few public education programmes and vocational or other types of training programmes focusing on organic farming. There are training and educational programmes that do not focus on organic farming practices, but still offer knowledge on more sustainable alternatives to conventional practices. There are some training programmes that cover regulation and other aspects of organic conversion. These are usually organised by AKIS actors actively involved in the development of clusters, farmer umbrella organisations, and even certification bodies. Most training programmes and knowledge transfer events are linked to EU projects. At national level no effort has been made to develop training programmes for advisors to improve their knowledge of organic farming.

Advice / consultancy

In Romania, organic farmers and processors do not have access to extension services specialised in organic agriculture, and there are no concerted efforts to change this any time soon. There are not centrally coordinated, strategic efforts to develop advisory services for organic. Existing advisory covers general aspects, such as sales support, assistance in internationalization and Business to Business (B2B) negotiations, branding, marketing, or business plan development. AKIS actors formally responsible for

professional training of advisors for organic are not in place. Therefore, advisory service providers in most cases are not sufficiently familiar with organic farming, certification requirements, or the conversion process. Moreover, there is little effort to improve farmers' access to extension services.

Conclusion

The strength of the Romanian AKIS for organic agriculture lies in regional cooperation and commitment of different actors. Current developments aim at strengthening the position of organic actors within the system. Challenges persist, however, in terms of fragmentation, funding, coordination, and specialisation. On the one hand new policy goals are set to improve coordination and target training; on the other there is not a clear implementation plan on how to achieve these goals.

3.2. Policies and funds supporting AKIS in the focus countries

In the following sections, the political background of and the funding mechanisms for AKIS in the focus countries are presented.

Policies supporting AKIS development

In all the focus countries, a policy background is established to support a well-functioning AKIS. Such a background includes governmental support to foster knowledge creation and transfer linked to advisory services, training and education and support for-profit and non-private actors that can provide further support to the sector. However, none of these countries identified AKIS for organic agriculture as a separate structure from the agricultural knowledge and innovation systems for conventional agriculture.

This is also evident in the 2023-2027 Common Agricultural Policy Strategic Plan (CAP SP) where each focus country refers to agricultural knowledge and innovation system development, but not necessarily using or relating it to the definition of AKIS defined by the European Commission. Each CAP SPs sets the framework of general AKIS but none of them identifies specific targets, goals and structural changes for AKIS for organic. Only the CAP SP for **Austria** and for **Germany** mention AKIS for organic stating that they are part of the national AKIS system.

AKIS policy objectives for the new funding period

The analysis has identified the following main policy orientations for AKIS for the next funding period.

I. Strengthen and further develop the structures of existing AKIS for organic, especially regionally (AT, DK, DE)

In **Austria**, **Denmark** and **Germany** the organic sector is well established, accompanied by a supportive AKIS for the organic. The overall policy goal formulated in the countries' CAP Strategic Plans for the next five years is to maintain and further develop the AKIS. While the **Danish** CAP SP strictly focusses on the maintenance of the already existing AKIS, in the case of **Austria** and **Germany**, the focus is more on local and regional actions and to establish further coordination bodies and information-sharing platforms among the relevant actors. Furthermore, attention is given to strengthen the research-practice-advisor cooperation, to improve knowledge exchange and to foster further research topics for practice as well as cross-federal, cross-border and international innovation actions.

II. Foster innovation partnerships and digitalisation (HU, RO)

The organic sector development in **Hungary** and in **Romania** shows similar features in relation to the policy context of organic farming. The development of policy regimes is dominated by the strategies of the European Commission. The national CAP SPs are in line with the EU strategic targets but there are gaps in the implementation, especially at the local level. **Romania's** CAP SP (European Commisson, 2023) considers advisory services and training needs, includes support for knowledge-based resilience of farms, and promotes collaboration among stakeholders and innovation partnership. The strategy also addresses digitalization and precision agriculture. **Hungary's** new CAP SP (European Commission, 2023) measures target innovation related actions, advisory services and digitalization.

III. Strengthen cooperation among actors of the knowledge and innovation system, and implement overdue targets (FR, IT)

Both **France** and **Italy** have well-established organic sectors. As for the targets and goals in the CAP SPs, **France** and **Italy** mainly focus on strengthening the cooperation among actors of the knowledge and innovation system, and on implementing the targets already set over the last two decades. The French CAP SP (European Commisson, 2023)aims to further strengthen training and support to cooperation, innovation, digitization and better knowledge flows.

Funding AKIS activities

Two main strategic areas for AKIS funding have been identified:

I. Funding for knowledge creation and innovation

Funding for knowledge creation and innovation mainly depends on public funds in **all focus countries**. EU funding linked to various EU programmes is especially important for **Hungary** and **Romania**, but also national R&D programmes and other grants (e.g., in the case of Romania private organisations or investors) complemented funding.

In **France** and **Germany** funding for developing knowledge and innovation structures usually relies on publicly funded network projects. In **France**, the share of CASDAR funds targeted at R&D in organic farming remains limited to less than 10% of the available funds. The State's investment in this field remains low and is much lower than in **Germany**, as highlighted by the experts interviewed. **Germany** has a dedicated research programme for organic farming, but funding levels have changed over time. Although in countries like **Germany**, **France** but also **Denmark**, funding structures for knowledge creation and innovation have been established, there are gaps seen in allocating sufficient funding for applied research and innovation to the knowledge needs of the organic sector.

II. Funding for advisory services, education, and training

Public funds also play an important role in funding advisory services in **all the focus countries.** In **Hungary** and **Italy** in particular, EU funds play an important role to finance advisory services. In other countries, advisory services mainly rely on national public funds as in the case of **Germany**, where the share of responsibility between the federal and the regional level is also reflected in the financing of advisory service. Here, a mixture of state funds, RDP and other private funds is used to finance advisory services. In **Italy**, RDP funds cover the very few specific services available for small-scale organic farmers.

Overall, the financing of advisory services has been identified as key bottleneck to the development of AKIS for organic. This weakness is related not only to financial resources, but in many cases even to difficult application procedure as highlighted by experts in **France**, **Austria** and **Denmark**. In **Austria**, the Organic Farmers' Association (Bio Austria) needs to collaborate with the Chamber of Agriculture to be eligible for national funding for extension services and consulting. Still funding for extension services is described as insufficient and comes with high administration requirements. In **France**, the lack of funding to cover extension services adds to the difficult relationships between advisory structures (such as GABs and CDAs) in some regions. However, in **France**, the Fomabio network of public and private agricultural education with an organic orientation, recognized by the State, will benefit with financial resources

between 2022 and 2025 from the Ecophyto programme. Yet, the use of these financial resources is hampered by the lack of human resources for coordination and implementation of training and education in organic farming.

In addition to national funding, experts also indicated the importance of service fees from farmers to finance support provided. In **Hungary**, farmers who apply for organic subsidies are required to hire a consultant from a list of consultants approved by the Chamber of Agriculture, who will provide them subsidized advisory services (90% of their consultancy fees can be reclaimed). The fees of advisory services provided by input-providers, or any other non-accredited organisations cannot be claimed back, which makes them more expensive. In **France**, farmers usually pay a fee for advisory services that may vary in value between regions and providers. Some Regional Councils cover fees for organic advisory service. In **Austria**, training for organic farmers is coordinated at a national level. The most relevant courses provided by the Rural Institute for Further Training (LFI) are subsidized, where 50% of the fees are covered by regional development programmes (funded by EU, state, and federal states). The additional training programmes offered by organic associations are not covered by the subsidy schemes. The same accounts for **Denmark** with the courses offered by ICOEL.

3.3. Organisation and collaboration of the organic actors in AKIS

Although the system of agricultural knowledge and innovation is very complex, the analysis reveals certain patterns in the development of AKIS in the countries studied:

- AKIS for organic in **Austria**, **Denmark** and **Germany** can be described as well-established and functioning. The systems are marked by collaboration and mutual support, yet improvements are needed. Organic farmers of these countries are provided with largely comprehensive support in advisory services, as well as education and training, and have several possibilities to obtain information.
- AKIS for organic in **France** and **Italy** can be described as partly established, especially on a regional scale, but with gaps in coordination, collaboration and support provided for organic farmers**.** AKIS actors' efforts made in **Italy** are still fragmented, and their dissemination efforts are sporadic. Even though the system in **France** is quite well established and a wide range of services are available in the whole country, it fails to adequately provide comprehensive support because of competing institutions and a lack of necessary knowledge support form R&D actors.
- AKIS for organic in **Hungary** and **Romania** can be described as fragmented with major gaps in coordination, collaboration and very limited support provided for organic farmers or those interested in organic farming. The system is highly

dependent on international/EU cooperation projects and on the contribution of private companies to the provision of advisory services to organic farmers. Nevertheless, considerable efforts have been made to develop collaborative networks (e.g., by ÖMKi in Hungary, and by BioDanubia in Romania). Living labs and clusters tend to promote collaboration among a wide range of different AKIS actors.

AKIS actors and their involvement with organic

The analyses of organic AKIS based on the expert interviews show a great diversity of actors involved in the knowledge and innovation system for organic agriculture. In all countries, AKIS for organic is at the interplay of private and public actors who either focus both on organic and conventional or focus entirely on organic.

In the focus countries the following major actors/stakeholder groups can be defined:

- Public authorities.
- Research centres (public and private).
- Education oriented institutions (e.g., higher education/universities; trainers; vocational training centres; adult education (public and private)).
- Farmers' organisations (including Chamber of Agriculture and organic farmers organisations).
- Advisory service providers (private, public; non-profit, for profit).
- NGOs.
- Media.
- Farmers.

The interviewees agreed that **all countries** have the prerequisites for a well-functioning AKIS for organic. The key actors needed for a functioning AKIS in the individual focus countries are there, yet the relations among the actors vary between countries and even between regions.

In all cases organic farmers' associations play an important role in the national AKIS relevant sub-systems to organic sector. These organisations are usually private, and independent from the government; many of them are membership-based organisations.

Experts emphasised that some organic actors in AKIS (e.g., specialised organic research institutions, local authorities, farmers' associations, etc.) are making greater efforts to

coordinate their work and develop stronger networks than is the case in the conventional sector (e.g., in **France**).

AKIS collaboration and coordination

The analysis shows that the level of collaboration among AKIS actors might be related to the size of the country as well as the sector. An example is the rather small organic pig farming sector in **Denmark**, which is described as doing much better at self-coordination than the rest of the agricultural sector.

In smaller countries, the coordination of the structure takes place at national level (e.g., **Denmark**), while in larger countries the AKIS tend to operate at a regional level (e.g., **Germany**).

In some countries here is a lack of a coordinated AKIS that fosters regional efforts such as in the case of local clusters operating in **Romania**.

The analysis reveals, a diverse range of bottom-up and top-down efforts contributed to the development of AKIS for organic. Most participants indicated a combination of top-down and bottom-up as the driving force of the knowledge and innovation systems. Yet, the opinions range between the experts, even within the countries.

Interviewed experts who describe the relationship rather "top-down" point to a lack of communication between policymakers and other stakeholders as well as the lack of feedback on policy implementation to practitioners. Respondents in all focus countries highlighted the need for government support, not only financial, but also in terms of capacity building.

While "bottom-up" developments can be found in most countries, these are usually characterised by strong actors, often from a grassroots movement background, taking on responsibilities and having great influence, especially at the regional level.

3.4. Support to organic farmers provided by AKIS

Knowledge creation and innovation

In this section we describe how knowledge creation and innovation are organised in the focus countries by examining the topic from different perspectives. First, the centres of knowledge creation and innovation in each country are described. We describe the role of private and public research institutes and knowledge centres, and that of programmes and networks for knowledge creation and transfer. Since these structures do not give any indication of how relevant the provided knowledge is for practitioners, the

importance of practice-oriented and participatory research in the focus countries is discussed. Finally, the importance of e-learning platforms is addressed.

Hubs for knowledge creation and innovation

The main hubs for knowledge creation and innovation for organic farming in all focus countries are the universities, as well as public and private research institutions and knowledge centres (Table 2).

Table 2 Hubs for knowledge creation and innovation in the focus countries. (Source: AKIS interviews and online survey)

Knowledge and innovation hubs	Austria	Denmark	Germany	France	Italy	Hungary	Romania
Public research institutions	●	●	●	●	●	●	●
Private research institutions / Knowledge centres	●	●	●	●	●	●	●
Educational institutions	●	●	●	●	●	●	●
Research and innovation networks and/or programmes			●	●	●	●	
On-farm research networks	●	●		●	●	●	●
Demonstration farms	●	●		●	●	●	●
Living labs				●		●	●
Organic farming associations		●	●	●	●	●	
Territorial entities / villages					●		
Individuals of the organic sector						●	●

Private and public research institutes and knowledge centres

Private and public research institutes play a significant role as knowledge hubs in all the focus countries.

Private research institutes or knowledge centres are considered to be the main knowledge hubs for organic farming especially in **Denmark**, **Romania** and **Hungary**. ÖMKI in **Hungary**, ICOEL and SEGES in **Denmark** and the consortium InterBio, with four clusters active in different regions and knowledge centres in **Romania,** they all play key roles in knowledge brokerage.

Public research institutes play a key role in knowledge creation and innovation in **Italy, Austria, Germany** and **France,** but even in these countries, private actors, such as ITAB in **France**, Naturland in **Germany** are also important.

Programmes and networks for knowledge creation and transfer

Research bodies often form alliances with other knowledge brokers. The range of programmes and networks which often enable synergies between organic, mixed, and non-organic AKIS actors are very important knowledge hubs in the countries studied (Table 6). Such networks in support of organic farm knowledge creation and transfer are seen on three levels:

I. Institutionalised programmes on the European level nationally implemented

The EU EIP-Agri projects are considered as essential to foster knowledge and innovation in organic farming by linking different actors within the AKIS. This pattern can be detected in **Austria**, **Germany** and **Italy**.

II. National programmes and initiatives

National multi-actor programmes are especially important in **France**, where specific programmes, events and networks are important knowledge hubs. Cross-cutting inter-institutional programmes and the organic metaprogramme run by INRAE (Metabio, which enhance interdisciplinary research) are good examples. These programmes allow for synergies between organic, mixed, and non-organic AKIS actors.

III. Local networks and events

Besides the large programmes for knowledge creation, local networks and events also provide inputs to innovation. In **France**, local organic farming groups as well as the Chamber of Agriculture organising events for knowledge exchange and innovation in organic farming. In **Italy**, the strong decentralization of AKIS is also reflected in the importance of local hubs as local groups as "Gruppo AIAB Torino", "Gruppo Friuli (regional body, AIAB)" or local networks as the "Network of advisory services in Tuscany" or "Biodistricts (INNER)". Knowledge hubs are also related to specific sectors (e.g., the

Italian network for peasant seeds "Reti semi rurali") or areas and villages as San Michele all'Adige or Laimburg for fruticulture and viticulture.

On-farm research networks, demonstration farms and living labs

On-farm research networks, demonstration farms and living labs are important knowledge hubs for practice-oriented research in **almost all the focus countries** (Table 6). The importance of living labs was especially emphasised for **France**, **Romania** and **Hungary**. For example, ÖMKi has been facilitating an on-farm research network of more than 100 farmers, where different organic research topics initiatives are co-created using the living labs approach.

Importance of practice-oriented and participatory research

In France, Italy, Denmark, Germany, Hungary and **Romania,** research is (mostly) practice-oriented and adapted to the needs of the organic sector. In **Denmark**, ICROFS and ICOEL are making efforts to improve the knowledge exchange between researchers and advisors. In **Italy**, efforts have been made to promote knowledge exchange and practise-based research initiatives. In the case of **Germany**, experts highlight that the research culture should be more participatory, and more efforts should be made to map the knowledge needs of the organic sector as well as and to manage the information flow. In **Romania**, organic farming research is still at an early stage. The lack of mutual trust and structured dialogue make knowledge transfer difficult. Knowledge exchange between researchers, advisors, SMEs, and farmers works well, where there is good cooperation enabling environment provided by the clusters.

Importance of e-learning platforms

In almost all the focus countries, e-learning and information platforms are in place. One important e-infrastructure mentioned by the experts in **Denmark** and **Germany** are Organic Eprints, which is an international open access archive for scientific papers and projects related to research in organic food and farming. Also, AKIS actors' websites play a key role as easily accessible information hubs in **Denmark** and in **Germany** (Ökolandbau.de). Overall in most cases there are no centralised or national e-infrastructures available for knowledge exchange, but there are several platforms with limited scopes and for specific audiences. For example, in **France**, there is a range of online knowledge-sharing platforms (e.g., BIOBASE-OK-NET at the EU level), but these

platforms are not connected to each other, and some of them are not user-friendly enough as highlighted by experts.

Advisory services

This section deals with the organisational characteristics of the advisory services in the focus countries, the themes covered by the advisory services and the tools and methods used. Specific attention is given to knowledge and skills of advisors for organic.

Organisational features of advisory services

The analysis of the organisation of advisory services highlighted some similarities and differences in the way official advisory services are organised in the focus countries:

I. Role of organic and conventional institutions in advisory services for organic

- Organic as well as conventional institutions mark a well-established advisory system in **Austria**, **Germany** and **Denmark** for the organic sector.
- Conventional farming institutions provide advice all over the three countries, but with different priorities in different regions in **Denmark.**
- In **Italy**, **Hungary** and **Romania,** organic as well as conventional farming institutions provide rather limited support to organic farmers.
- Conventional agricultural institutions (Chamber of Agriculture) are the main service providers for advice for organic farmers in **Hungary.**
- Organic and conventional agricultural institutions provide organic advisory in **France**, but with competing interests and; activities run with no coordination or cooperation**.**

II. Role of certification bodies to provide advice

- Knowledge gaps in AKIS for organic often push certification bodies to provide support to organic farmers, especially in **Hungary**

III. Role of private business and individuals as supporters

- In **Italy**, there are only few advisory services providing support to organic farmers, dependent on knowledgeable and dedicated private individuals.
- There are very few advisors in **Hungary** and **Romania**. These are either employed by some international input providers or trade companies. Some foreign consultants are invited in the country by farmers for systematic assistance.

IV. Country-wide support versus regional significance

- The regional clusters are important in facilitating cooperation between AKIS actors and thus providing more comprehensive support to **Romanian** farmers. In **Italy**, some regions show a very well organised support for farmers, but the efforts made regionally are unable to influence other regions due to a lack of knowledge dissemination plans and collaboration with AKIS actors across different regions.

V. Specific services provided to small-scale farmers

- A specific focus is on small-scale farmers in **Denmark**, **Italy**, **France** and **Hungary**. Some advisory service providers specialise in working with small farmers in **Denmark**, as quite a big proportion of Danish organic farmers run small farms. Few advisory services focus on addressing small-scale farmers in Italy. Advisory services in **France** are mostly responsive to specific knowledge needs of small-scale organic farmers, despite their regional differences.

Topics addressed through advisory services

The analysis of the interviews reveals that even in countries with well-established advisory services, the main support provided is for administrative, legal and technical aspects to organic farming. The interviewed experts mentioned a number of topics that need to be addressed by AKIS for organic in the future (Table 3).

Table 3 Current topics addressed in AKIS for organic and further knowledge needs (Source: expert interviews)

Countries	Support provided	Needs
Austria Denmark Germany	• Main focus on production and technical related aspects (DK, AT, DE) • Direct marketing assistance provided by some larger advisory organisations (DK) • Production and technical related assistance, some market integration, branding, and marketing provided by organic farmer associations (DE)	• Assistance in digitalization, new production technologies, diversification, market development, especially for niche products (AT) • New forms of marketing, and processing (AT)
France Italy	• Good support to organic conversion (Gab and CDA networks) (FR) • Incomplete support for organic farmers ("knowledge gaps") (FR) • Assistance in production and technical related issues, sales and direct marketing (IT)	• Assistance in market development and up-to date market information, branding, processing, use of social networks, rural development, sustainable management of soil and other land resources, re-design of farming systems after conversion (FR) • Expand advisors focus from only certain crops or themes (soil fertility, plant disease) (IT)
Hungary Romania	• Administrative support to organic subsidies application process (network of Agricultural Chamber) (HU) • Assistance in production and technical related issues provided by advisors, international input providers and grain traders (RO, HU) • Specialised support for cereal farmers mainly rely on their business associations (RO) • Assistance in sales support, in internationalization and B2B negotiations, branding, marketing, and business plan development provided in the clusters for organic farmers and other actors of the organic supply chain (RO)	• Improve practical and technological know-how relating to organic farming (esp. in the network of Agricultural Chamber) (HU) • Improve specialised support for fruit and vegetables producers (RO) • Improve support for farmers in conversion (HU)

Tools and methods used in advisory services

Online survey respondents indicated a number of different methods and tools to support certified organic farmers and farmers in conversion throughout the focus countries (Figure 6).

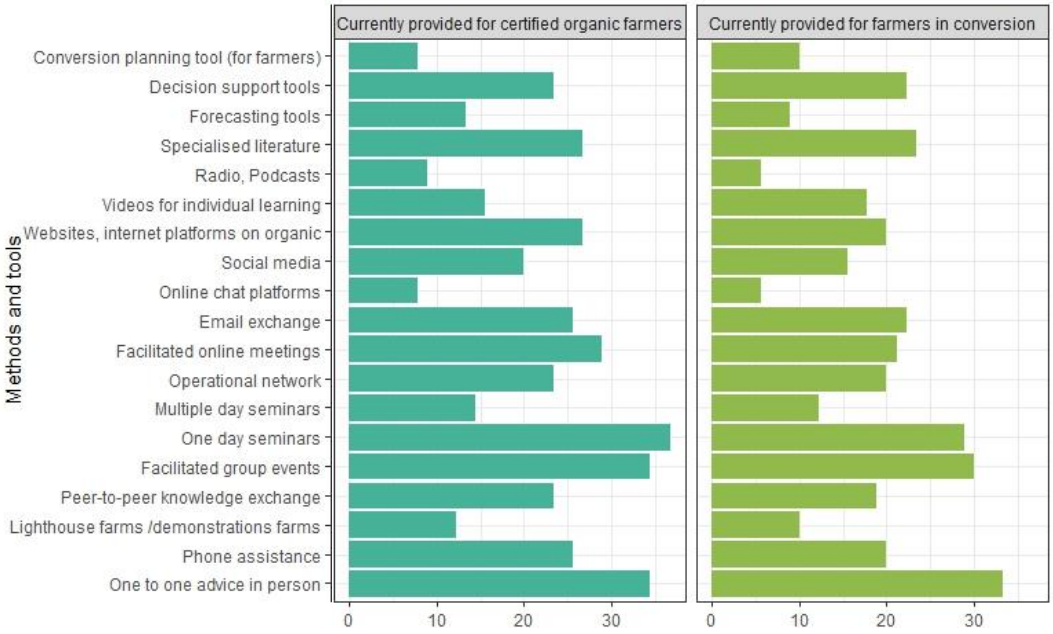

Figure 6 Methods and tools used by AKIS actors to support farmers. (% of respondents) (Source: on-line survey) (n= 81, on-line question: Please indicate which are currently the main methods and tools used by your organisation to support organic farmers (farmers in conversion and/or certified farmers)?

Based on the views of the AKIS actors, one-on-one advice in person, facilitated group events and one-day seminars are the most important approaches to support farmers. However, for certified organic farmers, peer-to-peer knowledge exchange is even more important than one-on-one advice in person. The online survey also reveals that facilitation of networking amongst farmers is one of the most important provision that farmers in conversion rely on, followed by assistance to compliance with legal and technical advice.

Advisors organic farming knowledge, skills and training

According to the survey respondents, advisors' knowledge of organic farming ranged between "partly good/partly no knowledge" and "they have a good understanding of organic farming but they are not experts". Advisors update their knowledge on organic farming through specialised training courses, facilitated group events, online platforms and websites, with no relevant variations between the focus countries. Except for **Romania**, all the focus countries offer some sort of training for advisors. However, experts very often highlighted the poor offer of such training and the need for more regular and better coordinated training (on federal level in Germany).

Training and Education

The following section briefly outlines the organisation of training and education in organic farming in the focus countries. The main insights into training and education are summarised in Table 6 Most supporting actors in the focus countries for processors and retailers, highlighted by interviewees.

Organisation of training and education

- Agricultural schools and higher education on organic farming

In **most focus countries** at least some agricultural schools and/or universities offer courses and programmes either entirely focussing on organic farming or offering organic farming lectures as part of a module system. A two-year European MSc programme in organic agriculture and food systems is jointly offered by universities in **Denmark**, **Germany** and **Austria.**

- Training for farmers

In **most focus countries**, training courses are offered for organic farmers normally by the public educational system and by private organisations, e.g., organic farming associations. In **Hungary** and **Romania** workshops and training on organic farming are mainly organised as part of an international research project / EU programmes. These projects increase and/or diversify the training opportunities in all countries, but in the case of these two they are key.

Table 4 Overview of availability of training and education specialised in organic farming (Source: expert interviews)

Countries	Availability of training and education for farmers	Agricultural schools and higher education on organic farming	Training and education for advisors
Austria	- Most important: LFI courses - Additional: organic associations training programmes	- One three-year agricultural college on organic farming (Bioschule Schlägl) - Several agricultural colleges with a focus on organic farming - Two-year university MSc programme in organic agriculture and food systems jointly offered by Hohenheim in DE, BOKU in AT, Aarhus in DK)	- Training available
Denmark	- Organic associations programmes (ICOEL)	- Training programme and courses on organic farming at agricultural college (Landbrugsskolerne) - Two-year university MSc programme in organic agriculture and food systems jointly offered by Hohenheim in DE, BOKU in AT, Aarhus in DK)	- Training available
Germany	- Training events for farmers from organic farming associations and advisory services (one to two day seminars)	- One or two-year courses at agricultural colleges (e.g.: Landshut, Weilheim and Kleve) - Some university education specific on organic farming on BSc or MSc level (e.g., Hohenheim, Kassel, Eberswalde) - Modules and/or professorships in organic at most other agricultural universities	- Training available
Italy	- Training, coaching and technical assistance to farmers, processors and consultants by Federbio in collaboration with training centres,	- University courses on sustainable agriculture (including organic practices e.g. University of Perugia, University of Milan) - Specific university course for organic agriculture production (University of Padova on organic vegetable production), not permanent	- Training available for advisors and organic inspectors by the third sector operators (e.g Federbio)

	universities, agro-food companies, and associations		- Training, coaching and technical assistance to farmers, processors and consultants by Federbio in collaboration with training centres, universities, agro-food companies, and associations
France	- Training by Fomabio network of public and private agricultural education - Training of network of agricultural chambers	- Training (vocational baccalaureates and high schools) with "organic agriculture orientation"	- Training available (e.g. training centre RESOLIA for advisors of agricultural chambers)
Hungary	- Shorter courses on specific aspects of organic farming outside the official higher education system (no 'formal' qualification for converting farmers) - Workshops and training on organic farming organised as part of an international research project	- MSc programme on organic farming at MATE University of Life Sciences	- (Follow-up) training and other events available for advisors within the agricultural chamber's advisory network (e.g., training by ÖMKi)
Romania	- Training on regulatory aspects of organic conversion by AKIS actors - Training and knowledge transfer events linked to EU programmes	- Some training programmes on conventional practices that present organic as alternative practice	- No training programmes for advisors at national level

3.5. Conclusions and recommendations

The following section highlights the main insights from the assessment of AKIS for organic based on the expert interviews and survey in the focus countries.

Key issues relating to the development of AKIS for organic

A well-functioning organic AKIS is dependent on conventional AKIS actors and their willingness to support organic farming

One common characteristic in **all the focus countries** is that organic provision in AKIS is not recognised either politically or institutionally, which results in a lack of strategic planning and funding. The strengths of an AKIS system largely depends on the received institutional support, and the presence and influence of significant institutions that are often specialised or at least committed to the development of the organic sector.

The effective provisions for organic in AKIS as in **Denmark**, **Austria** and in partly in **Germany** depend on the support and collaboration with conventional players. The involvement of conventional stakeholders has massively increased the importance and outreach of AKIS for organic and more farmers interested in organic farming.

Overall, there are differences of the current AKIS systems between the countries, which seems to be somewhat related to the scale of the organic sector in the country. The bigger the organic sector within the agricultural sector in the country, the more actions for development have been implemented over the last decades. Experts agree that the key actors needed for a well-functioning AKIS for organic are already present in the AKIS of the individual focus countries.

In countries with less developed ecological AKIS, a very important role is played by private market actors

In countries with poorly developed AKIS, private market actors often take over AKIS functions. In a profitable market like the organic market, organic farmers often rely on their business partners for support. In this case, the development of advisory services for organic farmers is mainly market driven (e.g.: by processors, input suppliers, seed suppliers, etc.) as seen in **Hungary** and **Romania**. This is contrary to the other focus countries where it is mainly farmer oriented and respondent to farmers' needs. Another characteristic seen is that certification bodies and organic farming associations are often the only ones able to satisfy the knowledge needs of organic farmers, and farmers in conversion. These bodies are also important in well-established AKIS.

EU programmes play a crucial role in shaping the development of AKIS for organic

The EU projects (e.g. EIP AGRI) provide opportunities and funding for regular international and in-country exchanges of experience, pilot adaptation of best practices, operational models and cooperation. The projects also provide the opportunity to prepare training materials and organise training courses. These initiatives contribute greatly to the development of AKIS for organic in all the countries, however they are particularly important in countries such as **Hungary** and **Romania** where other public initiatives are usually lacking.

Local ties and networks are important knowledge hubs, but also compensate for the deficiencies of the organic provisions in AKIS

A diverse range of bottom-up and top-down efforts contribute to the development of AKIS for organic. The participatory approach is common in the development of AKIS for organic, with key actors having a background in the grassroots movement and sometimes with political influence at the regional level.

Local networks such as the cluster system in **Romania** or more institutionalized networks like advisory networks in **Germany**, **France** or **Italy**, are important for knowledge exchange and support between farmers and farmers organisations. While the exchange of information in such networks is often well organised, these networks remain partly closed and do not manage an upscaling at a supra-regional level because of a lack of systematic support and funding. This prevents the flow of knowledge across regions. However, there is a need to share the often high knowledge and expertise that individuals (especially advisors and farmers) have accumulated locally and to ensure that it is available and adaptable in other regions as well.

Focus of organic themes in AKIS is limited to production-based support

While organic agriculture is a knowledge system and the conversion to organic agriculture requires support in many areas of the farming system, topics on organic in AKIS are mainly related to production and technical issues, which covers only one part of the learning spectrum. Also, there are often knowledge gaps in learning materials for organic, courses, and training. Hence, trainers and farmers need to rely on the same information available for conventional farming, with the exception of **Denmark**.

Bottlenecks and lock-ins6 in the development of AKIS for organic

The analysis revealed several bottlenecks to and lock-ins (annex) in the way the AKIS for organic are organised and the support is provided (annex). Even though differences in

[6] There are overlaps between bottlenecks and lock-ins, and the meaning of the terms cannot always be clearly separated.

the organic AKIS development exist, the identified lock-ins are quite the same for all the focus countries. These can be summarised in five main areas:

I. Insufficient organisation of AKIS: actors involved and collaboration

From the interviews, it emerged a lack of r development vision for AKIS for organic. In some cases, we also found competing interests and even conflicts within agricultural AKIS between organic and conventional sectors and actors. One bottleneck highlighted in the interviews in **Romania** and **Hungary** was the lack of independent advisory services provided to organic farmers. Service needs are often addressed by input providers and/or trade companies. Because of the lack of services provided, farmers in some cases turn to certification bodies to seek assistance. Yet, certification bodies are not officially mandated to provide advisory services to organic farmers. Additionally, cross-regional advisory services are missing.

II. Lack of funding and financial resources linked to policy commitment

The lack of (institutionalized) funding was one of the main bottlenecks identified by almost all the interviewed actors to knowledge creation and innovation as well as advisory services, training and education. Overall, **most focus countries** rely on programmes and projects and less on funding from institutions when it comes to knowledge creation, innovation as well as advisory services. These often come with a high dependence on the availability of calls, which are often not related to local knowledge needs, marked by high administrative efforts application and implementation. The lack of funding is also reflected in a competition for the little available resources. Overall, the lack of funding is linked to an overall policy commitment to support AKIS, which varies between the countries. Yet, political commitment is needed for the development of good structures and less bureaucracy and also in support of the overall willingness of AKIS actors to get involved in organic.

III. Lack of knowledge transfer and exchange

The lack of knowledge transfer and exchange was one of the main bottlenecks identified by the interviewed actors to knowledge creation and innovation as well as advisory services, training and education. On the one hand, there is too little interest from the research community in organic agriculture, on the other hand, when research projects produce relevant outputs, these are not processed and disseminated in a practical and coordinated way. There is also too little exchange and cooperation between researchers, advisors and farmers and among farmers themselves. There is a lack of exchange beyond the local level, as highlighted above. There are not enough efforts made to establish more systematic dialogues among the AKIS actors working with organic, nor enough collaboration among academic institutions. While too little is known about research needs in the field, not much knowledge is produced that can support trainers and extension service providers. Although online knowledge-sharing platforms are getting more attention and interest, these platforms too are not well connected yet to

each other. Overall, the lack of knowledge transfer and exchange is especially evident between research and advisory services. Often advisory service providers are not involved in knowledge sharing networks. The actors setting R&D goals are not well connected with those providing advisory services.

Governments in charge of funding allocations should ensure that actors in AKIS for organic have access to consultation processes with researchers and other advisors to ensure that their knowledge and assistance needs are being heard and that they have enough influence on setting the priorities, deciding on the focus areas of R&D and the curriculum of academic courses and training programmes.

IV. Lack of long-term vision in organic farming research

One of the main bottlenecks related to knowledge creation and innovation refers to the lack of long-term vision of research, which is expressed by several factors: insufficient political will, institutional structural instability, structural re-organisations, strong focus on some sub-topics and/or competing views, lack of collaboration among relevant actors and the overall lack of academic actors who work on organic. Applied research programmes, especially those with a participatory approach, require the establishment of partnerships between actors in charge of R&D and training programmes, and the actors in charge of implementation as well as more long-term security of funding.

V. Lack of organic curriculums in training and education, agricultural schools and universities to educate farmers and advisors

The identified institutional support for the organic AKIS has two main levels: higher education and research as a combination of efforts focused on knowledge development and sharing, while secondary education and practice-based training mainly provide knowledge sharing.

A lack of organic curriculums in training and education, in agricultural schools and universities to educate farmers and advisors has been highlighted in all the focus countries. The lack of organic curriculums in training and education also leads to a limited outreach to non-organic actors, which results in a limited availability of educated and skilled advisors and a lack of interest to consider organic as a valuable approach to train farmers. A comprehensive establishment of organic curriculums on all levels will be necessary for the further development of AKIS and organic agriculture.

Recommendations for the development of AKIS for organic

Several recommendations are identified to overcome the bottlenecks and lock-ins for the development of AKIS for organic:

I. Foster organisation of AKIS: involved actors and collaboration

- Foster capacity building of actors in AKIS for organic
- Support AKIS actors in a bottom-up and participatory approaches
- Encourage networking and collaboration among regional and international organic farming organisations
- Strengthen and support independent knowledge provisions and knowledge transfer infrastructure for organic farmers
- Implement cross-regional specialised advisory services

II. Support sound funding and financial resources linked to policy commitment

- Establish and implement clear-cut policy visions and strategies on sectoral level accompanied by mandatory implementation plans and attached resources in co-creation with actors across AKIS for organic
- Implement long term and institutionalised funding opportunities for R&D, advisory services, training and education in organic farming
- Allocate targeted national funds to support research, education and advisory services to embed results to practice
- Re-think bureaucracy level attached to funding systems for AKIS for organic to assure easier access to resources and funding

III. Foster knowledge transfer and exchange

- Establish/support central organisational bodies to coordinate actions in R&E, education, training, advisory services
- Support farmer willingness to become active agents in knowledge dissemination and exchange and get involved in participatory research
- Strengthen platforms and dissemination structures to foster capacity building beyond existing circles of organic actors (digital and physical)
- Foster practice-oriented scientific knowledge dissemination to organic educators, advisory and farmers
- Foster a centralized platform for sharing organic farming knowledge, best practices, and research findings. Make this information easily accessible to all stakeholders.
- Support on-line education and training for advisors and farmers

IV. Create long-term vision and support in organic farming research

- Map R&D needs for organic research
- Foster comprehensive organic portfolios in R&D
- Implement long-term strategies for research and innovation in organic farming
- Foster collaboration between research institutions, universities, and the organic farming community.
- Connect research projects and knowledge exchange.
- Support multi-regional and multi-national collaboration platforms between researchers on organic farming
- Allocate resources for research focused on organic farming practices and innovative solutions tailored to organic agriculture's unique challenges.

V. Implement organic curriculums in knowledge creation and innovation, advisory services, training and education

- Map AKIS actors and identify information and knowledge needs
- Implement a centralised coordination for organic education and training in agricultural schools and universities
- Create portfolios of existing education programmes for advisors in order to address comprehensive support beyond technical production related and administration topics (e.g., business development, marketing)
- Make it easier the access to mandatory training for advisors and farmers. Ease farmers access to training and education relating to organic agriculture
- Provide comprehensive knowledge portfolios to educators and trainers

4. Assessment of the knowledge and innovation system for organic aquaculture

This section of the report assesses the knowledge and innovation systems (KIS) regarding organic aquaculture. The assessment is supported by the overall approach used for the analysis of agricultural knowledge and innovation systems (AKIS), as highlighted above. The report addresses polices and funding supporting KIS as well as the characteristics of the KIS organisation and cooperation. Specific focus is placed on support in the areas of knowledge and innovation, advisory services, training and education. On this basis, it draws conclusions and recommendations for the further development of the KIS for organic aquaculture in the focus countries and in a wider European context.

Key facts and statistics on organic aquaculture in Europe

Organic aquaculture in Europe witnesses significant growth and recognition driven mostly by rising consumer demand for sustainable seafood options, with differences between the countries. In 2021, Ireland was leading the way, with 84% of its aquaculture production meeting organic standards, primarily in salmon farming, followed by the Netherlands and Slovenia with about 38% and 36% of their total production, respectively, and **Germany** with 26%. However, in most countries organic aquaculture represented still a low share of the overall aquaculture production, such as in France (4.7% in 2020), Spain (around 1.7%), and **Greece** (about 1.1%) (EUROSTAT, 2023b).

Organic aquaculture experienced rapid growth in several EU countries between 2012 and 2021. Bulgaria, Germany, Spain, and **Italy**, with minimal organic production in 2012, collectively produced about 39,000 tonnes of organic aquaculture in 2021. Ireland also significantly increased its organic aquaculture by almost 14,500 tonnes during the same period. However, Latvia, Lithuania, Hungary, and Romania saw contractions in their organic aquaculture, producing roughly 8,000 tonnes less in 2021 compared to 2012 (EUROSTAT, 2023b).

4.1. Summaries of KIS for organic aquaculture in each focus country

Germany

Summary of organic sector development

Unlike the development seen in agriculture, the organic aquaculture sector in Germany shows strong fluctuations between years. A decrease in 2014 and 2015 followed a strong growth in 2016, a substantial drop in 2017 and again a sharp increase in 2018. The rise in production in 2018 by more than 2000% is remarkable especially when put in the context of the stagnation seen in the aquaculture sector in Germany more generally (EUMOFA). However, it is unclear the cause of these fluctuations or if it relates to data inconsistencies. In 2020, 6.746 metric tons (mt) of organic aquaculture products were produced, ten times the amount produced 5 years earlier in 2015 (621 mt). In 2019 already 16% of total aquaculture production in the country were organic (EUMOFA), which is a considerably higher share than what we have seen for organic farmland since then in Germany. The most important species is mussel (6.500 mt/>95% in 2020). Other important organically produced species are trout (250 mt) and carp (15 mt) in 2020 (EUMOFA).

Policy background of knowledge and innovation systems relevant to the organic aquaculture sector

The German organic aquaculture has been regulated since 1996. Promotion of organic standards by association such as Naturland has helped to acknowledge and meet the needs of organic farmers (Naturland, 2023). In the last decade, the German governments have provided support to aquaculture through a wide range of policies aiming to maintain a certain employment level, to improve animal welfare and ensure the sustainability of the sector. However, there are no concrete policy objectives targeted at organic aquaculture neither in the CAP SP (European Commission, 2022) or in the political plans addressing SDG 14. A knowledge and innovation system for organic aquaculture is not mentioned in policy targets. The European Maritime, Fisheries and Aquaculture Fund (EMFAF) 2021 - 2027 Programme for Germany is key for the future development of the sector, with 69 million EUR allocated to sustainable aquaculture and processing (European Commission, 2022).

Knowledge creation, research and innovation

With most research targeted at the needs of conventional production, there is a lack of funding for research in organic aquaculture. Generally, knowledge exchange with practitioners is underdeveloped. Research results are difficult to implement also because of a lack of practice-oriented research and of and a central innovation hub for organic aquaculture.

Education and training

Curricula in educational organisation, such as vocational schools or academia are mostly designed around conventional topics, and topics more directly connected with organic aquaculture are neglected.

Advice / consultancy

Many advisory services exist in Germany for aquaculture, yet they mainly focus on conventional production, processing, retail and imports. Advisory services for organic producers or those willing to convert to organic mainly comes from a few certification organisations. Limited support is offered to organic producers in relation to market information and business development. Overall, both in organic and conventional aquaculture, extension services are mainly targeted at importers or large retailers.

Conclusion

The German KIS landscape for organic aquaculture is complex and characterised by a lack of coordination and innovation. While many advisory agencies exist, most of them offer support to conventional operators on issues relating to retail, processing and import. Only certification organisations support the organic and in-conversion producers. Even though they provide high quality support, the provision is rather limited because only few of the certification organisations work with organic aquaculture.

While self-organised platforms and approaches are currently making up for the deficiencies in the KIS for organic, more central coordination is needed considering the remarkable growth of the organic sector. So far, such the need to implement an effective knowledge and innovation system for organic aquaculture is not addressed by national policies.

Greece

Summary of organic aquacultural sector development

In Greece, 1.574 mt of aquaculture products were produced in 2020, which is an increase of 119% compared to 2015. This is a share of only about 1.2 % of the total aquaculture production of the country (131.645) (EUMOFA, 2022) and well below EU average for aquaculture (8.9%) and below the share of organic farmland in Greece in 2020 (10.1%). Aquaculture production growth in Greece is also lower than for the other countries analysed. Sea bass and sea bream are the species with highest production shares.

The obstacles in Greece is the complexity of the bureaucracy in organic aquaculture rules, regulation, and certification scheme costs and the unavailability of incentives, the price difference between the organic and conventional aquaculture products and the demand, unavailability of organic fish feeds and juveniles, while the supporting factors

are the consumer attitude and beliefs and the research towards the technical solutions and innovations in organic aquaculture.

Policy background of knowledge and innovation system relevant to the organic aquaculture sector

The Multi-annual National Strategic Plan for Aquaculture Development (2021-2030) stands as the sector's primary policy document. It mentions organic aquaculture only as a future option for sustainable production, while highlighting the importance of using recycled aquatic systems (RAS) and integrated multi-trophic systems (IMTA). It emphasises the need for uniform certification processes for both domestically produced and imported aquaculture products. In terms of the overall objectives of KIS the plan identifies further need of research and innovation, along with dissemination of results, promotion of cooperation among actors, networking, improvement of knowledge and training.

Knowledge creation, research and innovation

Researchers are not linked well to policy arenas as to translate their findings into policy actions. In contrast, researchers and farmers are well connected and collaborate. Knowledge exchange with the general public and stakeholders is insufficient. Consumers are not sufficiently informed about the products available which compromise consumer choice of aquaculture products from organic production.

Education and training

A practice-oriented advisory system through research institutions and universities is well established. Several educational institutions in Greece provide advanced training for interested students who, upon graduation, find employment in aquaculture facilities.

Advice / consultancy

The advisory services provided are considered sufficient for the few certified organic aquacultural farms. Research and academia have an important and proactive role in knowledge transfer. However, the small number of farms and experts available for extension services limit knowledge exchange and innovation needed for the further development of the sector.

Conclusion

The Greek organic aquaculture sector is stagnating due to production costs, lack of market demand and lack of well targeted subsidy system. Research and knowledge transfer for organic aquaculture are well-supported, though very few actors and institutions provide advisory services. More research and innovation are needed together with an effective knowledge exchange to allow key actors to acquire the competencies for further development of the sector (Multi-annual National Strategic Plan for Aquaculture Development, 2021-2030 (European Commisson, 2023).

Many initiatives remain isolated and not fully effective if there are no clear national targets at policy level and infrastructure that should support the knowledge and innovation system. As the sector is very small, effective collaboration and communication between actors works well, but there is a lack of consumer-oriented promotion of products from organic aquaculture.

Italy

Summary of organic sector development

Italy has the second highest organic aquaculture production after Ireland in terms of live weight. In 2020, 9.608 mt of organic aquaculture products were produced in Italy, accounting for 8% of the total aquaculture production. While this share is higher than the EU average (6.73%), it is also lower than that of organic farmland (16.7%). Aquaculture production growth in Italy was constant and considerably higher than that for the EU with the production value in 2020 being seven times higher than that in 2012 (1.3790 mt) (EUROSTAT, 2023a). The production of organic mussel is by far dominant also in Italy, accounting for about the 80% of the total organic aquaculture production. The other species produced organically are: Japanese carpet shell, Rainbow trout, European seabass, Gilthead seabream and Oyster (EUROSTAT, 2023a).

Policy background of knowledge and innovation system relevant to the organic aquaculture sector

The Italian Ministry of Agricultural Policies, in particular the General Directorate for the Promotion of Agribusiness Quality, plays a central role providing continuous funding for research and innovation projects for organic aquaculture. The main strategy in place is the National Strategic Plan for Aquaculture (NSPA) 2021-2027. The Plan highlights the importance of developing sustainable management systems and supporting the conversion of conventional aquaculture production methods towards organic aquaculture. Further targets of the NSPA are promotion of certification, support of collection of information, monitoring, and of small-scale fish-farmers.

KIS for organic aquaculture is not directly mentioned in the NSPA, yet it highlights the need to foster dialogue between public and private research bodies, foster research and innovation, support employment, training and vocational qualification, and improve knowledge transfer targeting business needs.

The Italian program of the “European Maritime, Fisheries and Aquaculture Fund (EMFAF 2021-2027supports the EU common fisheries policy (CFP), the EU maritime policy and the EU agenda for international ocean governance. It provides support for developing innovative projects ensuring that aquatic and maritime resources are used sustainably.

Similar to the NSPA, objectives and activities aimed at promoting the development of organic aquaculture in the national program of EMFAF 2021/27 are not defined in detail,

and in comparison to the key actions identified for the development of a 'sustainable' conventional aquaculture.

Knowledge creation, research and innovation

For more than a decade, the Ministry of Agriculture has been funding targeted research programmes, that play a key role in knowledge creation and transfer. Especially through its General Directorate for the Promotion of Agribusiness Quality the Ministry supports sectoral development by allocating funds for research and innovation projects related to aquaculture. However, a comprehensive national programme is missing. Farmers are broadly involved in public or private research focused on technical aspects of production, processing and consumer perception. These initiatives appear not strategic or institutionally frequent enough to ensure a well-functioning knowledge exchange. Overall, greater involvement of producers also in planning phases of research is desirable.

Education and training

In Italy there is no obligation to attend schools or special training courses to run an aquaculture farm. Farmers often have little knowledge on organic production methods. There are special funds to support training, but these remain largely unused due to too little interest specifically from small-scale producers.

Advice / consultancy

Aquaculture farmers receive support mainly as part of the certification process, less for the training part. The main topics of the advisory system appears to be technical issues of production, but it does not cover national/international markets, branding and marketing, which would be highly beneficial for farmers. The private advisory system does not seem to be particularly interested in promoting extension/advice services for organic aquaculture, and there seems to be little commitment at institutional level to fill the gap.

Conclusion

Organic aquaculture research programmes have been already initiated in Italy, involving both farmers, various institutions and research centres. These initiatives address technical aspects and consumer perception. However, a more strategic and consistent approach is necessary for the development of the sector. Furthermore, while aquaculture farmers receive consultancy support in the certification process, training is scarce. The current advisory system lacks focus on market integration, branding, and marketing strategies, essential for the sector's success. Given the fragmented network between actors and the limited interest in organic aquaculture from private advisory services, greater institutional commitment is required.

The willingness of Italian consumers to pay a premium for organic aquacultural products creates a favourable starting point, but challenges related to market availability and marketing strategies hinder the sector's growth.

The dynamics of knowledge and innovation system encompass a wide range of actors, with research institutions having substantial potential.

4.2. Policies supporting KIS development in the focus countries

The national aquaculture development plans/strategies examined either do not contain any objectives for the development of KIS for organic (Germany) or only mention the general thematic areas covered by KIS (i.e., dialogue between public and private research bodies, R&I projects, training and education, etc.) as general objectives, without any specific organisational aspects being addressed for the organic sector (Italy, Greece). The most relevant policy frameworks in place in all the three focus countries are the National Organic Action Plans, which all have organic aquaculture related chapter(s). Although, these plans show a potentially well-functioning general framework, organic aquaculture is mentioned with no concrete actions to be taken, specific content, objectives or approaches.

The same applies to the new CAP strategic plans, which do not include a vision, plan or supporting instruments, or any other reference to KIS for organic aquaculture. Nevertheless, the Common Strategic Agricultural Policy Plans 2023-2027 (European Commission, 2023) are positively assessed in all the three target countries in the online survey, which shows a positive attitude towards the policy orientations guided by the new EU strategies. However there has been little involvement of the representatives of the sector in the design process of these strategies.

4.3. Organisation and collaboration of organic actors in the KIS

In the following sections, we describe the actors involved in KIS for organic aquaculture, their cooperation and level of coordination in the countries studied.

KIS actors and their involvement with organic

In each country, organic KIS is at the interplay of private and public actors who work both with organic and conventional aquaculture. Only in **Germany** there are actors that work exclusively with organic aquaculture

The following key actors/stakeholder groups can be identified in the focus countries:

- Authorities;
- Research centres (public and private);
- Education institutes (Higher education/universities; vocational training centres; public/private education centres for adults;
- Farmer based associations (including Chamber of Agriculture);

- Advisory service providers (private, public; non-profit, for profit);
- Certification bodies;
- Farmers;
- Consumers.

Experts in **all the three focus countries** agree that several actors have an important role to play in the sectoral KIS development, as they have specific duties which are, however, quite underdeveloped compared to conventional aquaculture or organic agricultural support system.

The farming associations are of particular importance as they have direct connection with farmers. Farmer organisations are crucial for sharing on-the-spot experience as well as putting forward requests for the interest of all other actors in KIS. In **Greece**, farmers' associations are the most important actors. However, together with certification bodies, they have not managed to promote effectively higher production standards and marketing strategies through technical advice. The government and state agencies, on the other hand, are responsible for setting incentives and targeted subsidies. In **Germany**, organic farmers' organisation and certification bodies' role is little considered compared to the other two countries, despite the relatively strong and well-developed organic sectoral cohesion in the general organic agricultural sector.

Although Chambers of Agriculture, farmer schools and advisory service providers are the main drivers of knowledge transfer, they are considered less important in organic aquaculture, especially in **Italy**.

The private sector is considered the least important actor in the KIS of the focus countries, which reflects little interest from most of the stakeholder groups. Likewise this is reflected in the characteristics of research projects and institutions that are normally disconnected from the policy arena and have little immediate relevance to the sector's main needs.

KIS coordination and collaboration

The organic aquaculture sector is relatively young and small in all of the focus countries. The actors within the KIS for organic aquaculture know each other, but their cooperation is limited by the small market, lack of vision and lack of well-defined financial support system.

In **Germany** the sector itself is a rather fragmented system with many actors and sub-groups. The coordination among these smaller groups has no central interest or organisational framework. In **Germany**, research is quite limited mainly due to a lack of funding and market interest. Cooperation is fragmented too and occurs occasionally mainly when there is a research programme that involves different actors. It is rare that research outcomes are considered by policy makers due to the researchers' low representation in the policy arena. This is true in the three focus countries.

In **Italy** the cause of the fragmentation of the KIS is the lack of institutional cooperation and a low interest in adopting the EU level certification processes. The largest retailers, who are the main drivers of certification, hold a powerful position in the sector.

In **Greece** the coordination and cooperation show very different characteristic from **Italy** and **German**. The sector is very small, and actors personally know each other. Knowledge and information exchange between researchers and farmers works well, there is also good cooperation between advisory service providers and training providers.

In **Germany** and in **Greece**, public authorities have a more top-down communication (information and demand providing), while in **Italy** the two-way communication is more common, involving actors as equals in the sectoral decisions.

Yet, there is frequent and well-established cooperation between universities, and public and private research centres, which is well channelled to farmers and to farmers' associations in all the countries. The lack of close cooperation with NGOs also slows down the development of the sector. The relationship between famers and for-profit organisations as processors and retailers are not as developed as within other agricultural sectors, and the lack of market demand for organic aquaculture products is one of the lock-ins of the knowledge transfer in the sector.

4.4. Support to farmers provided by KIS

In the following sections, we look at support for organic farmers, focusing on knowledge creation and innovation, advisory services, training and education.

Knowledge creation and innovation

This section highlights the knowledge hubs for organic aquaculture and the importance of practice-oriented and participatory research.

I. Hubs for knowledge creation and innovation

The three focus countries indicated public research institutions as the main hubs for knowledge and innovation, followed by educational institutions and private research institutions. **Greece** and **Italy** indicated interactive hub types such as on-farm research networks, demonstration farms and living labs as part of the knowledge creation and innovation network (Figure 6).

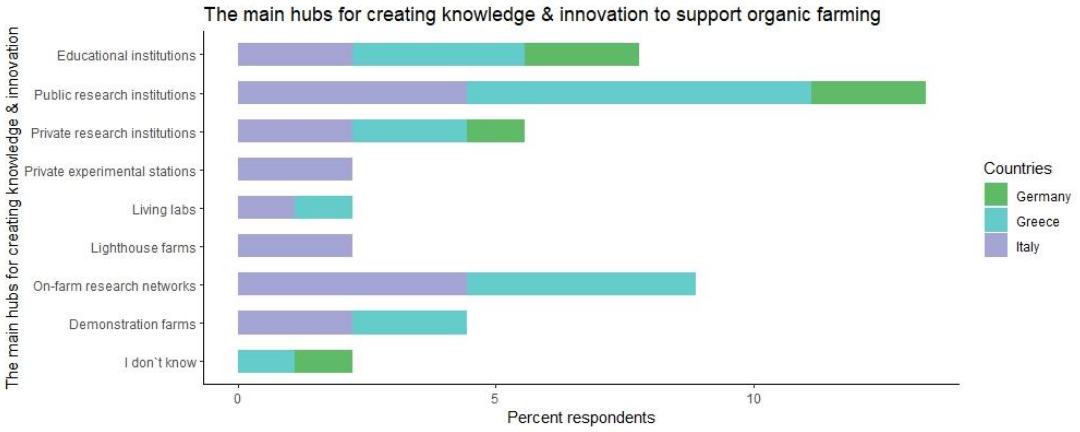

Figure 6 The main hubs for creating knowledge and innovation to support organic aquaculture in the three focus countries. (Source: on-line survey) (n=17, on-line survey question: Which are the main hubs for creating knowledge and innovation to support organic farming in your country?)

II. Importance of practice-oriented and participatory research

In **Germany**, there is very little research focusing on organic aquaculture. Research is not practice-oriented, and even the few practice-oriented research findings fail to get to farmers because of a lack of dissemination.

In **Greece**, research on organic farming is practice-oriented, and scientific results in most cases manage to get to the relevant target groups. The biggest gap in knowledge creation is recognition of organic aquaculture by policy makers, thus resulting in a lack of funding for organic, strategic governance, and overall little financial resources dedicated to research.

The situation for organic aquaculture in **Italy** is in between the German and the Greek cases. The few research and innovation actions are funded by ad-hoc calls, while there is no consistent funding to support sectoral needs. Research results do not always get to farmers as research rarely involves farmers and on-farm testing activities.

Advisory services

Advisory services for organic aquaculture are addressed along the following topics: the services provided to farmers in organic aquaculture (maintenance and conversion), the services provided specifically to farmers in conversion to organic aquaculture, the tools and methods used in advisory services by advisors in organic aquacultural knowledge.

I. Services provided to farmers in organic aquaculture

The actors who participated in the survey (mainly from public educational/research institutions, certification bodies and organic farmers associations) indicated the services they provide to organic aquacultural farmers (certified or in the conversion stage) (Figure 7).

In **Greece**, farmers are mainly supported in the introduction of new technologies, to improve productivity, for administrative advice, to improve biodiversity and to convert to organic.

In **Germany**, the main support provided deals with administrative advice, biodiversity improvement, marketing and branding, the introduction of new technologies and the improvement of productivity under organic farming conditions.

In **Italy** all above-mentioned services except marketing and branding are identified as equally important. None of the respondents in the focus countries identify 'help with social network' and 'strategic business development', as a support service.

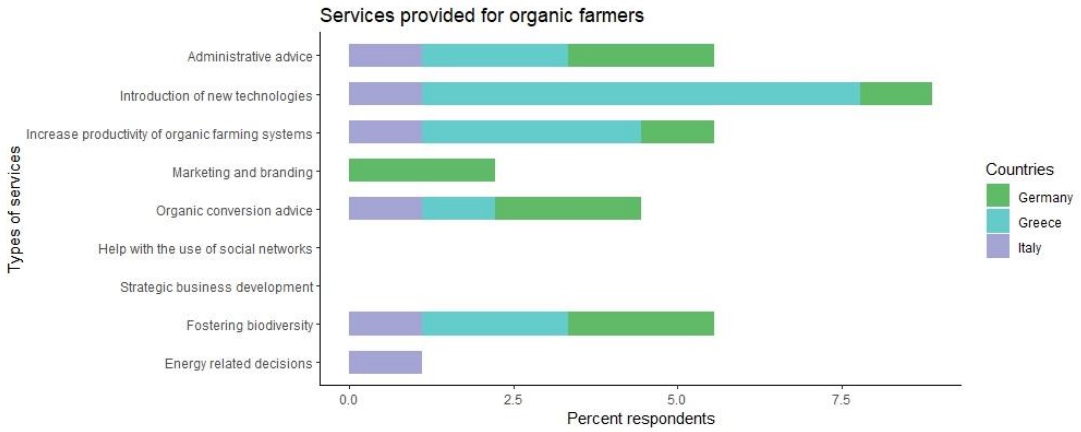

Figure 7 Services provided by advisors to support organic aquaculture in the three focus countries. (Source: on-line survey) (n=17, on-line survey question: Please indicate what services you provide to organic farmers (farmers in conversion or certified farmers) in your country?

II. Services provided to farmers in conversion to organic aquaculture

The stakeholders are asked in the survey to indicate the support they provide to farmers in conversion. The responses differ greatly by country (Figure 8):

In **Germany** four service types are identified in an equal ratio: conversion feasibility check, assistance to compliance with legal requirements, assistance for documentation and finally facilitation of networking among farmers.

In **Greece**, the assistance on documentation and technical issues are identified as prevalent. While conversion feasibility check, conversion planning and compliance with legal requirements are mentioned, none of the respondents considered that advisors support facilitation of networking amongst farmers.

On the contrary, in **Italy** facilitation of farmers' network is identified as the most developed service. Assistance to compliance with legal requirements and assistance with documentation are the only other services mentioned.

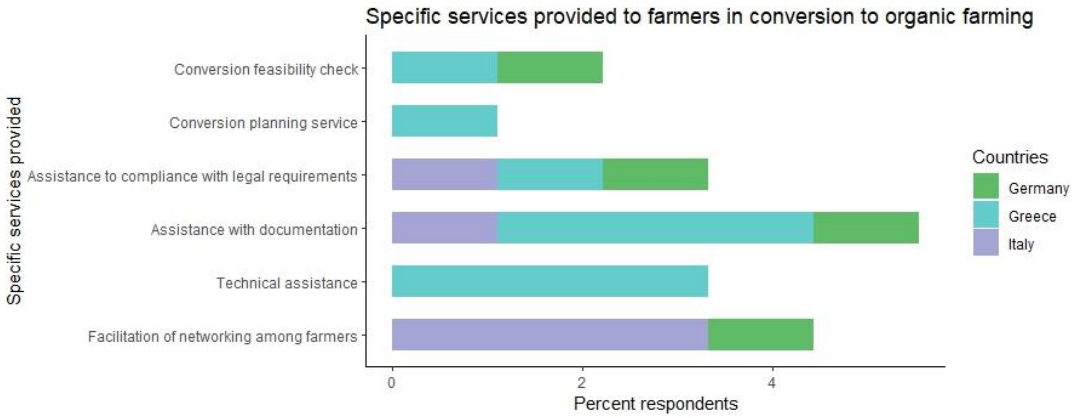

Figure 8 Services provided by advisors to support organic aquaculture in the conversion to organic farming in the three focus countries. (Source: on-line survey) (n=17, on-line survey question: Which specific services does your organisation provide to farmers in conversion to organic farming?)

III. Tools and methods used in advisory services

The characteristics of the small sector with a small number of actors involved which know each other well are reflected in the most important approaches to support farmers. The on-line survey respondents **in all the three countries** highlighted that support to farmers mainly occurs via email exchange. In **Germany**, the support by phone and one-to-one advice is also important (Figure 9).

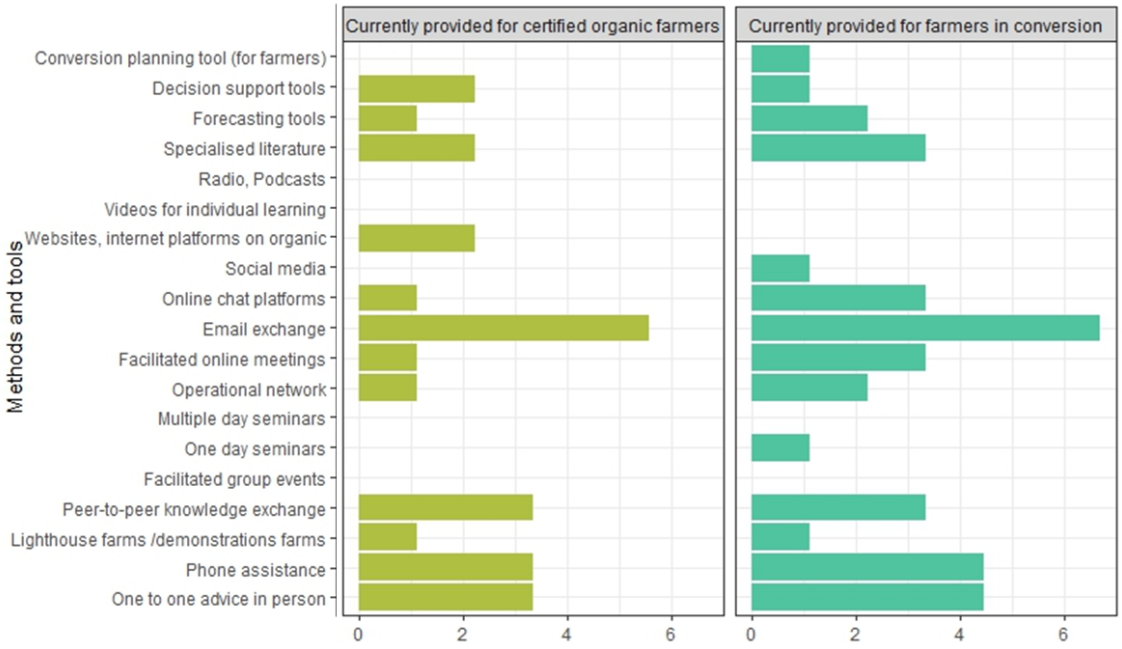

Figure 9 The main methods and tools currently used by the respondents' organisation to support organic farmers (farmers in conversion and/or certified farmers). (Source: on-line survey) (n=17, on-line survey question: Please indicate, which are currently the main methods and tools used by your organisation to support organic farmers in conversion and/or certified farmers)

IV. Advisors' organic aquaculture knowledge, skills and training

Most respondents to the survey indicated that their advisors partly have "good knowledge on organic aquaculture and partly they do not have good knowledge", followed by having "a good understanding of organic aquaculture but they are not experts". None of the participants indicated to have experts on organic aquaculture within their organisation.

It emerged from the survey that advisors access new information through specialised training, facilitated group events and on-line webinars. Some respondents indicated academic papers and specialised literature as the main sources of information, while for others these are not important at all. A smaller group sources direct information from agricultural living labs.

Training and Education

Training and education provided to organic aquacultural farmers follow the same pattern as the knowledge and innovation:

In **Germany** these services are underdeveloped, as conventional aquaculture trainers and vocational schools do not recognise organic aquaculture as a subject.

In **Greece**, training and education are appropriately provided, and farmers can find support from different knowledge exchange sources.

In **Italy**, there are some training and education programmes. However, the willingness to attend these programmes by farmers is low, due to a lack of interest in investing time, and money (especially amongst small-scale farmers, who are the largest group of organic aquaculture farmers in Italy).

An important bottleneck for **Greece** and **Italy** is the basic knowledge gap as most of the advisory service providers are not involved to vocational and professional training.

4.5. Conclusions and recommendations

The following section highlights the main remarks emerged from the assessment of KIS for organic aquaculture. The interviews and online survey carried out in the focus countries led to some key insights, bottlenecks and lock-ins, as well as recommendations for further development of the KIS for organic aquaculture.

Key characteristics of KIS development for organic aquaculture

Organic aquaculture is a small sector with few, but dedicated actors involved in partly well-functioning networks. However, the development of KIS in terms of knowledge creation and exchange, advisory services, education and training is low.

The organic aquaculture sector is very small compared to other agricultural sectors with few but dedicated actors who support each other and form a relatively well-functioning networks such as in **Greece**. On the one hand, this allows close collaboration and

knowledge exchange among the few actors, and short information communication channels. On the other hand, lack of general KIS in advisory services, education and training in all the three countries, there is no structured and continuous support provision. As seen in other cases in this report (sections 0 and 5), certification bodies are often the only ones able to meet farmers' advisory needs. The lack of comprehensive KIS involves the isolation of and missed support to the farmers out of the small networks, as well as those interested in converting to organic aquaculture.

The lack of a political basis for the development of KIS is caused by the lack of political strategies and objectives for the development of organic aquaculture.

All the sub-sectors of organic farming are now significantly influenced by the new EU strategies and CAP requirements Organic aquaculture is highlighted in these main strategies. In many cases it remains with a mention of the promotion of organic aquaculture without concrete objectives and measures, which is also a missing opportunity for the development of a knowledge and innovation system for organic aquaculture. As a result, the small sector is constrained by a lack of appropriate acknowledgement by policy in strategies and accordingly a lack of financial resources for KIS. Further growth of the sector seems to be difficult to achieve in this context, considering that the impetus for the development of the sector has been mainly relying on governmental initiatives and strategies.

The importance of public research institutions and host organisations in the KIS is high, while the role of private sector is minor.

In **Italy** and **Greece**, research actors play an important role within the KIS networks. Researchers and the limited size of the sector facilitates the introduction of new technologies and innovative practices via a well-established cooperation among research and practitioners. In **all the three countries**, though famers associations are considered as important actors in the KIS, farmers and farmer-associations bottom-up involvement and empowerment is lower than other agricultural sectors. Their representation within organic aquaculture does not reach the critical mass to get the appropriate attention in policy making processes. The consequences of such a lack of driving initiatives are an oligopolistic market for retailers and processors, and small representation in the policy arenas and at every level of knowledge exchange. Compared to organic farming, the private sector is considered the least important in the KIS for organic aquaculture, indicating the small business opportunity identified so far.

The low developed market is also due to insufficient KIS development.

In contrast to organic farming (Session 0), one aspect stood out in the analysis of organic aquaculture, namely the importance of market development supported by consumer awareness as a key factor for the development of the sector. Experts saw a connection between the lack of consumer awareness and knowledge, expressed in weak market development, which in turn is seen as an obstacle to adequate KIS development. While this is true for **Germany**, but also for **Greece**, consumers in **Italy** seem to have a

more positive attitude towards and trust in organic aquaculture products. As a result, the Italian market is still small, but the strongest one of the three case studies. As a reflection, the Italian KIS seems in parts more advanced.

Recommendations for KIS development on organic aquaculture

The above-mentioned characteristics show a young sector, whose development can be sped up. The recommendations below for the growth of the sector are described as actions to take to overcome identified bottlenecks and lock-ins:

I. Lack of aquacultural strategic plans, action plans and funds to support KIS

- Establishment of specific units on organic aquaculture in national and regional governmental bodies, in chambers, to support legislation
- Development of strategic and mandatory development plans, including communication and marketing plans
- Provision of allocated funds addressing KIS development for organic aquaculture

II. Lack of institutionalised knowledge creation and dissemination

- Foster development of practice-oriented research system (beyond ad-hoc research projects), together with a multi-stakeholder engagement process to facilitate effective knowledge transfer
- Support knowledge creation and exchange based on farmers needs
- Establishment of mechanisms to feed research results to advisory system, training and education
- Foster on-site experience and knowledge sharing

III. Lack of structured support for advisory services, education and training

- Integration of organic aquaculture profiles into the organic advisory system and in organic curriculums in education and training
- Promotion of the development of the private sector especially educators, trainers and advisors

IV. Lack of organic aquacultural market development

- Set up of consumer-oriented communication strategy together with retailers to improve consumer awareness, engagement and demand

5. Assessment of KIS for organic processors and retailers

This section of the report provides an assessment of the knowledge and innovation systems (KIS) with regard to organic food processing and retailing. The assessment has been supported by the overall approach of analysing the agricultural knowledge and innovation systems (AKIS), as highlighted above. Based on qualitative interviews, this section addresses the characteristics of the organisation of the support system for organic processors and retailers, as well as the main actors involved. It highlights areas and methods of support and addresses supporting needs. Based on this, conclusions and recommendations are drawn for the further development of organic processing and retailing in a European context.

Key facts on organic processing and retailing

In Europe, there are 84'799 organic processors (+3.8% compared to 2019) of which 78'262 are in the European Union (+3.4%). Considering the focus countries of OrganicTargets4EU, the country with the largest number of organic processors in 2021 was Italy, followed by Germany and France. Romania and Hungary account for the lowest number of organic processors (FiBL, 2023). Table 5 highlights the number of organic processors in the focus countries, excluding organic retailers due to the lack of available data.

Table 5 Number of organic processors in the focus countries in the year 2021

Countries	Organic processors
Austria	1'925
Denmark	1'162[7]
France	14'859[8]
Germany	19'536
Greece	1'756
Hungary	489
Italy	23'802
Romania	161

The assessment of organic processors and retailers knowledge and innovation systems (KIS) is done by focussing on two aspects: (i) on the main actors and main

[7] Data from 2020
[8] Data from 2017

characteristics in the way the system is organised, (ii) on the support provided, on the supporting needs and the methods used.

The following assessment on the knowledge and innovation system for organic retailers and processors covers all product groups. Nevertheless, individual sections of this report specifically address the situation for processors and retailers who are involved in organic aquaculture.

5.1. Summaries of KIS for organic processors and retailers in each focus country

Austria

In Austria, there are several AKIS actors providing support for organic processors and retailers. Examples are the organic farming association Bio Austria, which is providing advice and occasionally offering specific training programmes for processors and retailers. Further important actors are the agricultural chambers, research institutes, certification bodies and associations from Germany (Table 6Table 6).

There are two important actors from Germany supporting Austrian processors, the above mentioned AOeL, which also has members in Austria, and the BNN, which is also very well known in Austria. AOeL supports with its working groups and its peer-to-peer exchange, which is considered by interviewees as the most important and efficient knowledge transfer for processors in Austria.

In Austria, interviewees highlighted the first point of contact for processing companies to be the organic control bodies. They are legally not allowed to give advice, but they are allowed to inform about the legal rules and needs. Another important source of support are retail chains with own brands (e.g., Hofer with Ja Natürlich) with well-established support structures, internal guidelines and related training and advice for suppliers.

In Austria, interviewees highlighted the overall willingness of cooperation between actors in the food chain. The local, regional structures make it easier to exchange and to support each other.

Denmark

In Denmark, several private and public actors are actively engaged in supporting the knowledge and innovation system for organic processing and retailing, as indicated in Table 6. AKIS actors are involved in supporting processors and retailers, with their own networks established addressing processors and retailers. The most important actors involved are actors from the organic farmers associations, NGOs, the food department of the Ministry of Food, Agriculture and Fisheries and the Danish Agriculture and Food Council as well as the Aarhus university.

The Association "Økologisk Landsforening" (Organic Denmark) was identified as playing an important role in supporting organic processors and retailers. They support

processors and retailers interested in and dealing with organic products in terms of e.g., market research or consumer trends information. They furthermore and provide networking opportunities for organic processors and retailers interested in export in different kind of informative events and workshops, as e.g., at the Biofach or the organic food fair in Sweden. Government bodies facilitate market opportunities for processors and retailers in terms of out-of-home catering, public canteens, hospitals, kindergartens etc.

Germany

In Germany, a range of important actors are identified: organic farmers associations, NGOs, processing associations, private advisory service providers, public as well as private research institutes, press/media (Table 6). Support for organic processors and retailers very often rests on AKIS actors, which provide mainly technical and administrative support, some support direct marketing, and others offer specific advisory services for organic processors and retailers. Many associations of the AKIS have employees only responsible for organic and other sustainability certifications. Besides, single independent consultants fill in the gap of specialised support that associations hardly provide (e.g., product development).

Besides AKIS actors, there are two private actors specifically focussing on processing and retailing. One is AOeL (Assoziation ökologischer Lebensmittel Hersteller e.V.), a processing association from Germany. AOeL supports specifically on legal issues related to organic processing, such as the interpretation of standards, in providing position papers to the organic law, import guidelines, supporting in handling with residues and quality assurance. AOeL has 12 working groups implemented with different focus areas. Within these working groups training is provided on specific topics based on new knowledge. The second actor supporting with knowledge and information is the German "Federal Association of Natural Food") called BNN (Bundesverband Naturkost Naturwaren).

In Germany, public media was named as important in terms of providing relevant information on various topics especially for processors. Overall, one expert estimated that the sources of knowledge for organic processors rests on four equally important actors: the industry itself, the government, advocacy groups and independent consultants.

In Germany, interviewees highlighted that there is a coordinated exchange among actors, but still room for improvement.

France

In France, there are a range of public institutions and private organisations at regional and national level which are actively engaged in supporting the knowledge and innovation system for organic processing and retailing (Table 6). It ranges from research

institutes, chambers of agriculture, the organic agency of the ministry (Agence Bio), regional groups of organic producers, retailers' unions, individual consultants, association of certification bodies, certification bodies and NGOs as e.g., IFOAM. ITAB has a food processing group providing knowledge.

Good cooperation and networking among actors are mentioned in France on the level of supporting organisations. There is frequent cooperation at the trade union level among food processors/retailers. However, the processing and retailing sector is marked by a strong competition, hampering the exchange and knowledge transfer among processors and retailers.

Greece

Organic farming associations are not mentioned as important actors to support organic processors or retailers. Overall, there are some state bodies and agencies that are supporting organic processors and retailers as e.g., the Ministry of rural development and food or AgroCert[9]. However, interviewees highlighted a lack of political leadership arising from a clear vision for organic in terms of a national strategy.

In supporting processors and retailers, research institutes are playing an important role as well as private consultants and the organisation “Local food experts (LFE)", which assists food processing companies in terms of sustainable innovation, cost-efficiency and profitability.

Overall, a lack of cooperation among relevant actors is reported and a processing and retailing sector marked by strong competition.

Hungary

There are four actors mentioned as the most important actors supporting organic retailing and processing: The Hungarian Association of Organic Farmers (Biokultúra), the organic research institute ÖMKI, the agricultural chamber knowledge centre and the Herman Otto Institution, which belongs to the Ministry of Agriculture (Table 6). Biokultura organises science days, and their member organisations organise training programmes. They work together with other organisations in the organic sector.

There are no organisations that specialise in providing either administrative or practice-oriented assistance for those interested in producing organic food products. Organisations that otherwise assist small-scale conventional farmers and food processors, occasionally discuss with interested actors the prospects of entering the organic food market, the requirements of organic certification, and the applicable subsidies. In Hungary, there are subsidies for certification, procurement of raw materials, participation in training, and consulting.

[9] AgroCert is a state agency supporting research and knowledge dissemination, quality control and monitoring.

So far, well-established processors are the most important information source for newcomers as well as certification bodies. Certification bodies hold the problem of conflict of interest and are described as slow in the interpretation of international regulations that processors importing from and exporting to third countries would need.

Italy

In Italy, the most important actors indicated by interviewees to support organic processors and retailers are certification bodies, followed by a few qualified lawyers specialising in agro-food legislation and some consultants, food technologists, universities and other research institutes as well as organic sector organisations (Assobio, Federbio, AIAB) (Table 6). Large companies with organic lines have internal consultants within their quality departments. Overall, the system is described as uncoordinated and fragmented.

There is a lack reported on communication and knowledge exchange especially between processors and farmers and farmers' organisations. The sector is marked by high competition especially on the retailing level.

Romania

In Romania, processors and retailers argue for a lack of comprehensive support corresponding to their information needs. Partially because those needs have not been properly explored. A strategic approach and coordinated efforts to develop supportive services is missing. Nevertheless, regional clusters play a crucial role in supporting organic processors. For organic processors and retailers, important information sources are their current business partners, certification bodies, certain associations, IFOAM Organic Europe, Inter-Bio Association and FIBL.

5.2. Organising KIS for organic processing and retailing

Most important actors supporting

There are a range of actors actively engaged in supporting the knowledge and innovation system for processing and retailing as highlighted in the interviews (Table 6). Some actors operate on a European level, providing support to processors and retailers beyond country borders (e.g., IFOAM Organics Europe, Demeter International). Others are more focussed on supporting processors and retailers on a national level. Overall, there are differences between the focus countries in the support provided for processors and retailers. Support structures in **Germany**, **France** and **Denmark** are well established, but less developed in the other countries. In general, there are fewer structures established to support organic processors and distributors compared to organic farming. This is especially the case for organic aquaculture which is overall a very small sector with only few specialised processors and retailers to be present in the system in all countries. The actors in the focus countries which are active in knowledge providing can be categorized as following:

- Organic farming associations
- Research institutes public and private
- Certification bodies
- Government (State and federal authorities)
- Consultants (private actors)
- Companies (private actors)
- Press/media

The Table 6 highlights the most supporting actors along their type of organisation identified in each focus country.

Table 6 Most supporting actors in the focus countries for processors and retailers, highlighted by interviewees

Type of organisation	Austria	Denmark	France	Germany	Italy	Greece	Hungary	Romania
Organic farmers associations	Bio Austria, Demeter	Demeter Biodynamic Association Denmark, Okologsik Landsforening	FNAB, CIVAM, Regional groups of organic producers	BOeLW, Demeter, Naturland, Bioland, Bio Kreis	Assobio, FederBio, AIAB, AT Bio		Biokultúra Association	AgroTransilvania Cluster, Bioterra
Other NGOs		National cluster organisation for the Danish food and bioresource industry	IFOAM FR, Un plus bio, Cebio (certification bodies association)	WWF in cooperation with retailers	IFOAM			
National / Regional Government body	Bundeslehranstalten, AGES	Food department of the Ministry of Food, Agriculture and Fisheries; Danish Agriculture and Food Council	Agence Bio, Ministères			Ministry of rural development & food, AgroCert (state agency)	Agricultural Chamber, Herman Otto Institution	
Public advisory service and/or training provider	LKNÖ (chamer of agriculture in Lower Austria)		Chambers of agriculture					
Private advisory service and/or training provider	AOeL DE, SGS LVA GmbH		Critt sud, technical institute,	AOeL DE	Qualified lawyers specialising in agro-food	LFE		

Type of organisation	Austria	Denmark	France	Germany	Italy	Greece	Hungary	Romania
			individual consultants		legislation and some consultants			
Private research institute	FiBL AT, FiBL CH		ITAB, FiBL FR, FiBL CH	FiBL DE, FiBL CH	FiBL CH		ÖMKI, FiBL CH	FiBL CH
Public research institute	Bio Komptetenzzentrum Schlägl	Aarhus University	INRAE	University of Hohenheim, University of Kassel	CREA-AA Universiyà degli Studi di Scienze Gastronomiche, Laimburg, Research Centre for agriculture and forestry, Università di Pisa, Università Politecnica delle Marche	National Agricultural Research Foundations (ΕΘΙΑΓΕ)		University of Agricultural Sciences and Veterinarian Medicine Cluj-Napoca
Number of control bodies and control authorities in the organic sector[10]	9	2	12	19	21	15	2	14

[10] The respondents pointed out the importance of the control bodies without mentioning the actual bodies. There are a large number of control bodies in the individual countries; for this reason, only the number of bodies is highlighted in the table.

Type of organisation	Austria	Denmark	France	Germany	Italy	Greece	Hungary	Romania
Retailers	Trading companies with their own requirements for organic		Synadis		Trading/processing companies with organic lines			
Trade unions	BNN (Bundesverband Naturkost Naturwaren DE)		Synabio, Interpro	BNN DE				
Private Institutions[11]	LVA GmbH, LebensmittelFair Sicherung GmbH		Acta, Actia		San Michele all'adige agricultural institute			
Other				Press/media				

[11] Private institutions offer services as e.g., labels for organic products or quality analysis and monitoring of quality assurance for organic products.

5.3. Support to processors and retailers

Availability and access to information and education

The interviews revealed a mixed picture on the availability and access to information and education in the focus countries.

I. Availability and access to knowledge and information

A good availability of knowledge and information was highlighted by interviewees from countries with a well-established supporting system as in **Denmark**, **France** and **Germany**. **German** experts mentioned that there is ample knowledge, information and support available in good quality from a lot of sources (websites, associations, networks). This is the result of decades of experiences in working with organic certifications and labels. Also, for **France**, it is reported that, there are supporting organisations in food processing that disseminate knowledge and provide mentoring that have a fairly good impact among processors. In **Denmark**, the association "Økologisk Landsforening" covering support for the whole supply chain is seen as an important strength of the sector.

A lack of availability and access to knowledge of was mentioned in the **other focus countries**, marked by a less developed support system for processors and retailers. It was highlighted, that there is not sufficient expertise for organic processing in the public advisory services as well as partly in the private sector. In **Austria**, the support provided from the farmer associations was valuated as insufficient. In **Italy**, organic farmers associations are indicated as not very important and influential in supporting organic processors and retailers.

In **Austria**, experts argue that there are many years of experience in the organic sector, which goes hand in hand with a wide range of products and a good basic knowledge of the various product groups. But support structures for processors and retailers are only partly established. One reason for this seen is the high export of raw materials, which means that only a small number of national companies process organic food. The same was highlighted by actors in **Hungary** and **Romania**.

In **most focus countries**, a weakness highlighted was that information was not easily accessible to processors and retailers. This aspect was mentioned in countries with well and with less well-established support systems. There is a lack of an overview of what information is available, who can assist in terms of organic processing and trade, and what the needs of processors are. This is especially the case in countries with a range of different actors involved, such as in **France** or **Germany**. Experts in **Austria** and **Italy** criticized the lack of access to information, which leads to processors not knowing what organic processing means in terms of introducing organic product lines. For **Austria**, in line with a lack seen in knowledge generation and usability of information and a missing

overview of who can support, goes a lack of digitalisation of information and supporting services. The same was reported by the experts of the other focus countries.

Due to the fact that the organic aquaculture sector is relatively young, research has not yet provided all necessary results that processors and retailers specifically need. As a consequence available information and knowledge is scarce and searching for them require capacity and time to collect and analyse. Information is usually neither accessible in the national languages nor country-specific.

II. Availability of training and education

A good availability of training and education, especially for organic processors was mentioned for **Germany**, **Denmark** and **France**. This is contrary to **other focus countries**, which are marked by a lack of availability of training and education programmes, with some exceptions in **Austria**. In **Austria**, the main deficiency in training was seen in not having organic integrated into the training of e.g., cooks or food technicians. In **Italy**, there are three organisations which are able to provide qualified training, which is considered as insufficient to cover the company's needs. In **Greece**, some training seminars for processors are offered. In **Romania**, the lack of training was mainly mentioned in connection with the lack of training of consultants on organic. In **Hungary**, there are no secondary post graduate courses specific for organic farming and processing, as well as no specific training programmes, higher education or specialised advisory services for processors or retailers. However, the University for food engineering offers a secondary course in organic food law.

Current thematic areas for support

The interviews revealed thematic areas of support provided for processors and retailers:

I. Implementation of organic regulation and certification

In each focus country, actors exist which support on the implementation of organic standards and regulations as well as certification. In **France**, it was mentioned, that it is a clear advantage of organic processing, compared to organic farming, that processors and retailers are facing fewer constraints to produce/handle organic products while still focussing mainly on conventional products. In **Hungary**, it was mentioned that the conversion of a processor towards organic is not accompanied by too many technological challenges. Food processors already must comply with food safety regulations and the HACCP system. An exception are processors that are running organic and non-organic production units in parallel. Overall, conversion to organic farming is more challenging for small processors when it comes to meeting organic certification requirements. Larger businesses are more accustomed to meeting certain standards or specific administrative requirements.

II. Product development

Throughout the countries, support on products relates mainly to the use of the ingredients and additives, or if processing aids can be used in organic as well. The support provided does not guide the processors from the product idea to the final market product. Often large companies have in-house knowledge to support in product development, whereas SMEs are dependent on external support.

III. Sourcing of raw materials

There is assistance in **nearly all focus countries** on sourcing (product and material supply), mostly in connecting possible partners/suppliers with processors. Biokultúra Association in **Hungary** used to provide processors and retailers with a list of their organic producers, but this is no longer possible due to due to data protection rules. In **Denmark**, the challenge was expressed to source organic raw material for larger processors preferably from local sources as well as sourcing raw material which complies the organic quality needs.

Interviewees argue that many farmers are not ready yet to change their operations to organic, as they still have (good) access to a (secure) conventional market. This hampers the supply of organic raw materials.

IV. Provision of market data

General market data on the market shares of organic are available in **each focus country**. However, interviewees highlighted, that the availability of real-time international data about cultivation areas and production volumes is still insufficient.

In **Austria**, the Austrian Agrarian Market Agency provides processors with the national cultivation data necessary to plan their production. FiBL Austria is providing market analysis upon request. In **Denmark**, an annual "organic market report" is published. The market report contains forecasts from retail sector representatives on the development of the organic market. In **Germany**, market data is published by BÖLW once a year a "Branchenreport" and AMI publishes more detailed market data at a charge. In **Greece**, biopoiotita is providing market data. In **Hungary**, some market data are provided by the certification bodies. In **Italy,** support with regard market data is given with the restriction that only data about sales in largescale retail are available, sales in other channels are only estimates. In **Romania**, Biodi Nationa agricultural research and development gives support in market data. The interviewed referred also to the FiBL publication "world of organic".

V. Support in sales and market channels

Support on international sales and market channels of organic material/produce is existing in **several focus countries**, specifically in **Denmark**, **Germany** and **Austria**.

Methods of support

In most of the focus countries information for processors and retailers is available in the following formats:

- Specialised literature (e.g., brochures, leaflets, books)
- Websites
- Videos
- Face-to-face advice/extension
- Peer-to-peer learning
- Courses targeting specific topics
- Educational programmes targeting specific topics

Online support as a hotline to support processors or retailers is not implemented, but advice by phone or e-mail in a short term are available in all countries. Videos for knowledge transfer are partly established. In **Germany** and **Denmark** videos are well established, in **Greece** and **Romania** videos are not yet a common tool for knowledge sharing.

The availability of courses is also varying between the countries. In **Germany** and **France**, training courses about the organic regulations and principles of organic production and processing (production, nutrition and environment) are taking place. In **France,** training for processors on organic regulations are offered to consultants on demand (3 to 4 times / year). These take place online and face-to-face. Face-to-face training for retailers on the organic regulations are offered once a year.

Additional support needed

The most urgent need seen for action in supporting a sound KIS for organic processors and retailers is seen in several areas:

I. Organisation of advisory services

There is a need seen to develop and expand advisory services and establish specialised advisory services for organic processors especially in **Italy**, **Hungary**, **Romania** and **Greece**. In **Italy**, the need is seen to institutionalize competencies for organic processing within the public extension system and, in particular in the regions. These should provide at least basic support to operators (organic, conventional, multifunctional), which could then be complemented by private services.

II. Improvement of training and education

The education and training for the organic food processing professions is an important task and the interviews highlighted that this can be improved in **all focus countries**, also in the ones that already have implemented a range of programmes, such as **Germany**, **France** and **Denmark**. In **Germany**, there is the need seen especially for education and training to support skilled workers in organic processing and retailing. In **Germany**, also the need was expressed, that organic actors are integrated in the development of organic curriculums. It was suggested that organic associations will be involved as official partners in the further development of education programmes to be able to integrate organic as a thematic area.

III. Supporting tools: Information platforms, centralised databases and communication tools

Interviewees **in all focus countries** highlighted the need for information platforms, databases and digital communication tools. This would ensure a better overview of the existing knowledge and information and a structured and harmonised information flow. Some experts argued for a centralised platform which could make it easier to get the right information and contacts. A platform/marketplace to connect producers to food processors could be established to allow direct sourcing of raw material.

In **Hungary**, it was especially mentioned that educational materials (facts and figures, leaflets) to set up a food quality control system (HACCP) to enable dealing with organic products should be available, in a digital format or print format.

IV. Areas of support

Interviewees highlighted several areas of support needed. This can be summarised in two categories: (i.) technical and legal requirements and (ii) business development.

IV/i. Technical and legal requirements

- The certification guidelines and the legal frameworks get increasingly more complex, making it more time-consuming to meet all the requirements. Interviewees expressed concern with the new regulation of certified hygiene products that will be communicated in 2024 (new EU list). This will be an additional hurdle for organic processors with regard food safety as well as financial issues.
- For processors targeting foreign markets, it would be easier if the different organic associations would mutually recognize their private label standards (e.g.: Naturland <-> BioAustria).
- The standardization of pesticide residue analysis in laboratories in different countries would make the handling of commodities easier.

- There is a need seen to improve the information and knowledge on the use of additives in organic processed food and possible alternatives, food safety issues, new planned implementation rules with regard the handling with residues or cleaning and disinfection products. This was especially mentioned by interviewees in **France** and **Germany**.
- In **Denmark**, it was emphasised, that support is needed concerning the handling of unpackaged organic products (e.g.: bulk produce, fresh produce like vegetables and fruits) which come with additional requirements, and often discourage retailers handling such products. In contrast, the handling pre-packaged products with an organic label was described as to be not very demanding for retailers in terms of support. These products are sold mostly through the same retail channels as conventional products and commercial retailers do not need to be certified.

IV/ii. Strategic business planning and product development

- Interviewees emphasised the need for more support in successful business planning, from understanding the meaning of organic, prices, technical and administrative information, compliance to successful marketing strategies as B2B negotiations, branding, marketing. This was especially mentioned from actors in Greece and Romania.
- The need of support in the product development especially for small and medium size enterprises came up in nearly all focus countries, and especially in Italy. In France, the overall support to focus on SMEs was mentioned based on the experience with some financial support through the initiative "France relance" which is mainly directed to large scale processors which already hold resources compared to SMEs.
- In Denmark, interviewees highlighted, that the lack of product innovation hampers the increase of sales of organic processed food. Support is needed on product development, and applying technologies that allow for getting the volumes up and organic prices down.
- Interviewees highlight the increasing importance of sustainability assessments to processing and packaging. The German interviewees see a need to specifically support SME's on sustainability assessments.
- The need of transparent communication of the returns in investment in organic was mentioned in France. Processors need to see the direct return on investment in organic to motivate them to convert to organic processing.

V. Understand and envision "organic"

The need to communicate the benefits of organic farming and organic products from a scientific, technical and marketing perspective to processors and retailers, as well as to consumers was mentioned by several interviewees in the focus countries. The need for a coordinated effort to be made to develop a well-informed, more reliable actor base, which improves the trust in organic products was mentioned in **Denmark, France** and **Germany** where the market is already well developed, as well as in **Romania, Hungary, Greece**. Public awareness and information campaigns are mentioned for this purpose as well as "guiding personalities" (advocates), who stand up for organic: politicians and other celebrities, media-effective leading figures which promote the advantages of organic.
In **Austria** and **France**, a specific need was seen for the communication of core values and principles to processors and retailers, to be integrated in advisory services, training and education.

VI. Cooperation and coordination along the supply chain

High importance was given to connect the players in the supply chain for a more coordinated approach for knowledge and innovation in the organic sector. One interviewee suggested organisations such as FiBL or IFOAM Organics Europe taking on such tasks.

VII. Research and innovation: bring into practice

There was an urgent need seen by interviewees in **France**, **Germany** and **Austria**, to support practice relevant research on organic processing and elaborated knowledge to be brought into practice.

VIII. Changes in market conditions

Experts in several focus countries highlighted the need to reduce subsidies for conventional products and to increase subsidies for organic produce to equalize the market situation. Others expressed the need of true cost accounting of all food products, including the follow up costs caused by the conventional production. This would ideally result in more accessible prices of organic products and greater market demand, as indicated in **Hungary** and **Denmark**. In **Denmark**, there are ongoing discussions on the political level whether the VAT for organic products should be reduced. Instable markets due to insufficient demand for local/national products leading to high number of imported products was especially the concern by interviewees in **Hungary**. Overall, interviewees also in other countries raised the concern of low market demand caused by the inflation, which inhibits new processors to enter the organic sector. In **Denmark**, **Austria** and **Germany**, interviewees expressed the need to reduce the high costs for certification/labelling especially for new processors and retailers to set incentives going organic.

The need for changes in market condition was especially mentioned for organic aquaculture. In many cases, processors, and especially retailers, cannot make the minimum profit solely from organic aquaculture products, so they conduct their business with conventional products. This mixed conventional-organic trade and processing practice leads to conventional product-oriented practices which slow the development of the sector.

5.4. Conclusions and recommendations

In this study, 38 interviews are carried out with knowledge providers in the field of organic processing and retailing companies in the eight focus countries Austria, Germany, Denmark, France, Greece, Hungary, Italy and Romania. The respondents are composed of persons from processors, retailers, organic associations, research institutes, adviser and certification bodies.

Ample differences in the supporting systems

The interviews revealed considerable differences in the support for processors and retailers in the focus countries. In **Germany**, **France** and **Denmark**, support for processors and retailers is well developed. In Italy and Austria, some actors are actively supporting organic processors and retailers, but overall, the support system is less developed in **Hungary**, **Romania** and **Greece**.

Countries with a well-established supporting system for organic processors and retailers (DK, DE, FR)

The three countries with a well-established and developed support system share the importance of organic farmer associations, NGOs, public policy actors, as well as public research institutes in supporting processors and retailers. Overall, a multitude of public and private actors are involved, often with dedicated staff power and resources focussing on organic processing/retailing. The sector in these three countries is characterised by good cooperation and networking between the supporting institutions; also institutionalised peer-to-peer exchange is an important knowledge pool for processors and retailers. The well-established support system is marked by good availability and access to knowledge and information as well as training and education. However, interviewees in all three countries expressed room for improvement, especially in terms of training and education offers as well as systematic overview of who is providing what kind of information.

While the support system is established, processors and retailers are dealing with different kinds of challenges, such as high costs for production and certification as well as the challenge of locally available organic raw material, which was especially mentioned for **Denmark**. While actors try to further boost the market through product innovation, the challenge is to get adequate support and information on technical

adaptations and implementations, accompanied by practice-oriented research. In the well-established organic sectors, support for processors and retailers is also geared towards the export of processed organic products. Overall, support is often addressed towards large scale companies with a need seen to specifically providing support to SMEs. For the further development of the sector, the need is seen to build a common basis among actors of the supply chain on the principles and values of organic.

Countries with a less-established support system for organic processors and retailers (AT, GR, HU, IT, RO)

The countries with a less-established support system have in common a small to limited number of public and private actors to support organic processing and retailing, whereby organic is often one among other topics. Important actors providing support are often the certification bodies, and retails chains running their own organic brand. Organic farming associations are of lower importance in these countries with regard to processing. However, both actor groups can or do only provide a limited range of support, which mainly addresses administrative and legal support. Partly, processors and retailers rely on support from abroad, as seen in the case of **Austria**, where German associations play an important role. A reason for the less-established support systems are, apart from Italy, the low number of organic processors and the high amount of raw material going to export, as seen in the case of **Hungary**, **Romania** but also **Austria**. This is accompanied by a low demand for organic products on local markets as highlighted in the case of **Hungary**, **Romania** and **Greece**. This results in an overall need to strengthen local/national processing and sales structures in all levels of the supply chain.

Overall, the countries are marked by a low availability and access to knowledge and information, and training and education in the public advisory services as well partly in the private sector, with **Austria** partly excluded. A lot of support relies on peer-to-peer exchange partly organised in regional structures and clusters as seen in the case of **Romania** and **Austria**. However, such support is hampered by a strong competition within the sector, which was particularly highlighted for **Greece** and **Italy**.

Topics the systems are dealing with

Based on the analysis, the topics relevant to processors and retailers can be grouped along the following topics:

- Actors and visibility: missing overview of the actors involved, their services and qualification; partly missing commitment and leadership, partly missing cooperation

- Availability of knowledge and information: lack of (easy access to the) knowledge and information for processor/retailers, insufficient research and product innovation activities
- Organic in advisory services, training and education: lack of coverage of organic content in advisory services, and in curricula for education and training, and partly lack of qualified and dedicated staff working with organic
- Finances: high certification costs, partly missing state support for advice, still good prices and conditions for conventional processing and retailing

Key conclusions and recommendations

The assessment of knowledge and innovation systems revealed different approaches towards supporting organic processors and retailers in the focus countries. Learning from the different countries, the following key conclusions can be drawn:

- Involvement of organic farming institutions focussing on supporting organic processors and retailers, offers the advantage of having expertise and linkages throughout the supply chain
- Involvement of public policy institutions facilitating support
- Importance of research institutions to foster innovation
- Good cooperation and networking among organisations and actors involved
- Regional clusters and support groups fostering peer-to-peer exchange are especially important in countries with an overall less-developed support system

From the findings of this study, specific areas of support can be derived that are needed for the future support of organic processors and retailers:

Public policy actively engaged

- Public policy commitment: a vision, commitment and active role of competent authorities to build up the basis for support.
- Monetary policy tools to ease going organic, e.g., reducing the entrance barrier with financial support and information provision, especially for SMEs.

Independent knowledge sources

- Independent advisory actors to provide qualified support along the supply chain.
- Independent knowledge sources to support product development and innovation.

Coordinated efforts to multiply knowledge and information

- Independent actors and tools to bundle and harmonise available knowledge and support and to foster coordination and cooperation on a regional and national level and across country borders

Communicating and integrating "organic"

- Including organic curricula in educational programmes and vocational training based on the needs of organic processers and retailers.
- Building profound knowledge base on organic farming and food among processors, retailers and consumers.

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7. Annex

Bottlenecks of organic AKIS development

While most materials as detailed county reports, interview guidelines and online-survey questionnaire can be obtained on request, the following highlights the detailed country related responses on the bottlenecks identified in the focus countries:

(i) Organisation of AKIS: involved actors and collaboration

(ii) Funding and financial resources linked to policy commitment

(iii) Knowledge transfer and exchange

(iv) Long-term vision and support in organic farming research

(v) Organic curriculums in knowledge creation and innovation, advisory services, training and education

(i) Organisation of AKIS: involved actors and collaboration

	AT	DK	DE	FR	IT	HU	RO
Lack of independent advisory services provided addressing organic farmers needs		?					

	AT	DK	DE	FR	IT	HU	RO
Certification bodies to provide advisory services out of lack of available services provided by other AKIS actors							
Fragmentated organic advisory services with missing cross-regional specialised advisory services							

(ii) Lack of funding and financial resources linked to policy commitment

	AT	DK	DE	FR	IT	HU	RO
Knowledge creation and innovation							
Lack of funds for knowledge creation and innovation focusing on organic farming							
High dependence on international R&D calls							
Insufficient R&D funding focussing on the (local) needs of the organic sector							
Lack of institutional capacities of AKIS actors to respond to organic sector knowledge needs							
Lack of institutional capacities to apply for available funds							
Delays between the conception of an idea and the actual implementation of results especially in research projects dependent on public or EU funding							
Advisory services							
Lack of public and institutionalised funding for advisory activities							
High bureaucratic efforts attached to advisory services funded through projects							
Knowledge gaps for adequate organic farming support partly attributed to the lack of budget allocated to R&D in organic farming							
Lack of funds to cover extension services adds to the rivalry between advisory structures							
Training and education							
Lack of public funding for education courses for organic farmers							

(iii) Lack of knowledge transfer and exchange

	AT	DK	DE	FR	IT	HU	RO
Lack of (scientific) knowledge, processed and made available to organic farmers							
Lack of showcases to demonstrate innovative on-farm concepts (e.g. on-farm demonstrations)							
Lack of knowledge transfer between organic farmers as well as advisors and across regions							
Lack of structured knowledge management and lack of coordination behind the few knowledge dissemination efforts							
The lack of interaction and dialogue between actors in research and actors responsible for knowledge dissemination							
Unorganised and inefficient dissemination activities to compromise the availability of a plethora of existing valuable information to support the organic sector							
Lack of knowledge on advisors and farmers research needs							
Lack of advisors' capability to respond to sector-specific knowledge needs.							
Lack of trust to hamper exchange and knowledge transfer							

(iv) Lack of organisation and long-term vision in organic farming research

	AT	DK	DE	FR	IT	HU	RO
Insufficient political support to encourage AKIS stakeholders responsible for agricultural research and innovation to focus more on the organic sector							
Lack of motivation of academic research actors to reach out to assess organic farmers' or processors' knowledge needs							
Lack of motivation of academic research actors/groups to set focus on organic farming							
Discontinuity of the efforts made by a wide range of AKIS actors and lack of a common vision they could share for the future of the sector							

	AT	DK	DE	FR	IT	HU	RO
Destabilised academic community through politically debated reorganisations							
Competing concepts close to organic (e.g., localism, conservation agriculture, regenerative agriculture) creating competition for the available limited resources.							
R&D efforts focused on genetics leading to the detriment of other essential fundamental research fields of the organic sector (e.g. entomology).							

(v) Lack of organic curriculums in training and education, agricultural schools and universities to educate farmers and advisors

	AT	DK	DE	FR	IT	HU	RO
Lack of organic curriculums in training and education, agricultural schools and universities to educate farmers and advisors							
Lack of educated and skilled advisors in advisory services for organic farming							
Lack of advisors focussing only on organics							
Lack of integration of organic curriculum into the public agricultural education system							
Lack of schools and teachers' interest and understanding of organic farming							
Understaffing of teachers resulting in covering only very broad aspects of organic farming							
Students interest for prevailing agricultural practices							
Limited farmers interest to attend available training and education on organic farming							
Low availability of online courses addressing organic farmers							
Lack of newcomers' knowledge on organic out of missing conversions advice and courses							
Low incentivisation to attend available courses by farmers							