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INTERNATIONAL JOURNAL ON FOOD SYSTEM DYNAMICS

Int. J. Food System Dynamics 13 (4), 2022, 395-410

DOI: https://dx.doi.org/10.18461/ijfsd.v13i4.D2

A European skills strategy for the agri-food and forestry sectors – key challenges and prerequisites

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Received May 2022, accepted July 2022, available online August 2022

ABSTRACT

The Erasmus+ FIELDS project aims to contribute to skill enhancement of workers in the agriculture, food industry and forestry sectors, to be able to make full use of the opportunities and comply with requirements of the ''Twin'' Green and Digital transition. The FIELDS project focuses on the domains Digitalization, Sustainability, Bio-Economy and Management & Entrepreneurship. Skills include ''hard''/ measurable and technology-based skills as well as ''soft'' / transversal skills.

This paper reports on key challenges and prerequisites for the development of a European Agri-Food and Forestry Skills Strategy. Starting with the results of a European agri-food-forestry trend analysis and focus groups discussion on skill and training needs in 10 European countries, this paper presents the results of a follow-up survey among key stakeholders of the European skills ecosystem, including the following topics: prerequisites for the development of training programs, harmonization challenges in the European agri-food and forestry skills ecosystem, and monitoring and key performance indicators the European agri-food and forestry skills ecosystem.

The paper develops directions for a EU strategy on agri-food and forestry skills, including:

- In the development of training programs in Europe special attention should be paid to management/entrepreneurship and soft skills, the position of training in practice, possibilities for online training, and attention to underprivileged groups
- For the harmonization of the agri-food and forestry European skills ecosystem a common European catalogue and repository of training programs, linked to national systems, together with a system of micro credentials, is needed. This should be aligned with a harmonized certification system for VET courses/programs and VET providers. Agreement between public and private parties on the catalogue and certification system is essential.
- A supra-national institute should be responsible for design and maintenance of a monitoring infrastructure for skills. The system to be designed should be smart, user friendly, upgradeable and interoperable. The newly established Agri-food Pact for Skills can play a central role in the establishment and governance of an ''Agri-food Skills Observatory''.

Keywords: Skill needs; agri-food and forestry sectors; European trends; skills strategy; strategy prerequisites.

1 Introduction: the European agri-food and forestry skills agenda

This paper presents the results of a survey on the challenges and prerequisites for a European strategy on agri-food and forestry skills. The survey is executed among 25 key stakeholders of the European skills ecosystem, all members of the Erasmus+ FIELDS project. The aim of this project is to contribute to skill enhancement of workers in the agriculture, food industry and forestry sectors.

The FIELDS project is consistent with main EU policies in the fields of sustainable and circular production. The European Green Deal, announced by the European Commission in December 2019, followed up on the UN Sustainable Development Goals (SDGs) and COP21 (the UN climate change conference of 2015). It commits the EU to become climate-neutral by 2050 whilst promising to help companies to become world leaders in clean products and green technologies. It aims to boost the efficient use of resources by moving to a clean, circular economy while restoring biodiversity and cutting pollution. The Green Deal encompasses a New Circular Economy Action Plan, a Sustainable Europe Investment Plan, a Biodiversity Strategy for 2030 and, a new Farm to Fork strategy on sustainable food throughout the value chain (EU-Green Deal, 2021; EU, 2021a).

For the FIELDS project, sustainable food production, biodiversity, and circular economy are key issues. A circular economy is instrumental in delivering on the European Commission's ambitions to decouple resource use from economic growth. The Green Deal aims to halt, and as much as possible reverse, the pressures we place on our planet's resources, ecosystems, climate, and biodiversity. The Farm to Fork Strategy aims to enable the transition to a sustainable EU food system that safeguards food security and ensures access to healthy diets sourced from a healthy planet. The strategy sets concrete targets to transform the EU's food system, including a reduction by 50 % of the use of pesticides, a reduction by at least 20 % of the use of fertilizers, a reduction by 50 % in sales of antimicrobials used for farmed animals and aquaculture, and reaching 25 % of agricultural land under organic farming. It also proposes ambitious measures to ensure that the healthy option is the easiest for EU citizens, including improved labelling to better meet consumers' information needs on healthy, sustainable foods (EU-FarmToFork, 2021).

Biodiversity underpins vital environmental, social and economic functions. It is therefore not only placed at the heart of EU environmental policy, but the Commission wants biodiversity criteria to be fully factored into public, corporate and individual decisions at all levels, from farming and fisheries to trade, industry, energy, climate, and economic policy (Oneplanet, 2021).

Coherent with the Green Deal the new (post 2020) Common Agricultural Policy (CAP) aims to foster a sustainable and competitive agricultural sector that can contribute significantly to the European Green Deal, especially with regard to the Farm to Fork, circularity, and biodiversity strategies. Action points of this policy instrument are as follows: - better integration of climate issues as well as environmental issues such as biodiversity protection, natural resource conservation, and soil health and fertility, - access to healthy food for all EU citizens, - promotion of sustainable agriculture (Farm to Fork initiative): reduction of chemical fertilisers, pesticides, and antibiotics, nutrient losses, increase of the organic farming area, - support of digitalisation of agriculture to improve sustainability and competitiveness (EU-CAP, 2020).

In this paper we focus on the challenges and prerequisites for the establishment of a European Agri-Food and Forestry skills agenda. One of the aims of this task is to link up with the recently Established Agri-food Pact for Skills, spearheaded by the European association for the food and drink industry, FoodDrinkEurope, and the European association of cooperatives and farmers, Copa-Cogeca. In the outline of the Pact as proposed on the 18th of October, 2021 the Agri-Food Pact for Skills partnership states: ''The aim is to set a joint strategy to design and implement a sectorial upskilling and reskilling framework, maximising competitiveness of all the actors involved, job retention and job attractiveness for the agri-food system within the Pact for Skills'' (FDE - CopaCogeca, 2021; Pact for skills, 2021; Pact for skills, 2020; Lazaro-Mojica & Fernandez, 2021).

The Erasmus+ FIELDS project aims at skill development in Sustainable production, Bio-economy (addressing both sustainable and circular production), Digitalisation (to support sustainable and circular production), and Management and Entrepreneurship skills, including Soft skills. 'In this report skill needs developments in Management and Entrepreneurship and Soft Skills will be reflected by the term Business Models.'

The four-dimension Sustainability, Bio-economy, Digitalisation and Business Model are strongly interrelated (see figure 1). Bio-economy focuses on sustainable use of (agriculture and forestry) resources. Digitalisation supports and enables sustainable production, e.g. through the more efficient use of resources. A business model reflects the economisation of the use of resources and whether this takes place in a sustainable way, both environmentally as well as economically.

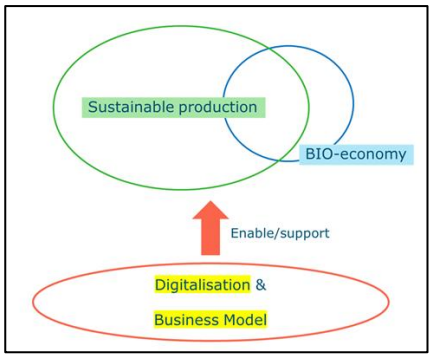


Figure 1. Project dimensions.

The paper is structured in three parts, all tasks of the Erasmus+ FIELDS project:

- Results of a European agri-food and forestry trend analysis
- Results of focus group discussions in 11 EU countries on agri-food and forestry skill needs
- The definition of challenges and pre-requisites to arrive at an integrated EU approach of the agri-food skills ecosystem

Section 2 presents results of the trend analysis, section 3 goes into the focus group discussions, section 4 discusses key challenges and prerequisites for a European skills strategy. Section 5 formulates conclusions and paths forward.

2 Trend analysis

In work package 1 of the FIELDS project a trend analysis was performed in 2021 to analyse the future needs in the fields of sustainability, bio-economy, digitalisation and management & entrepreneurship of the European agriculture, food industry and forestry sectors.

The EU level trend analysis has been performed by WUR (Wageningen University and Research Centre), PlantETP (Plants for the Future ETP), FoodDrinkEurope, GAIA-Greece and CEPI (Confederation of European Paper Industries). Seven country-specific trend analyses were performed by: WUR (the Netherlands), Confagricoltura and University of Turin (Italy), ISEKI (Spain), FJ-BLT (Austria), ANIA (France), Association of ProAgria Centres (Finland), ICOS (Ireland). All partners were supported by their FIELDS project country teams.

The trend analysis has taken as starting point a recent trend study from the Horizon2020 project Fit4Food2030 (Fit4Food2030.eu), in particular, deliverable 2.1: 'Report on baseline and description of identified trends, drivers and barriers of EU food system' (Wepner et al., 2018). Fit4Food2030 identified 60 trends in and beyond the food system in the EU (Wepner et al., 2018). These trends range from megatrends like climate change to more specific trends like the increase in the use of bio-based plastics.

We follow the definition of ''Trend'' from (Fit4Food2030.eu D2.1, page 4): ''A trend is a development or change over a long time, which is likely to affect society or parts of it after a few years. A trend cannot easily be influenced in a mechanic way by individual organisations, players, or nations. It is often a result of specific drivers or can be promoted by strong influencers. It becomes visible only in retrospective.'' Trend studies usually distinguish between megatrends and trends. Megatrends are defined according to OECD (2016), as ''large-scale social, economic, political, environmental or technological changes that are slow to form, but which, once they have taken root, exercise a profound and lasting influence on many if not most human activities, processes and perceptions.'' Trends, contrary to megatrends, focus at smaller, regional, or sectoral scale. Fit4Food2030 identifies 11 megatrends (Table 1) linked to Global socio-economic-technological developments.

Table 1.
Megatrends identified by the Horizon2020 project Fit4Food2030.

Megatrends identified by the Fit4Food2030 project	
Climate Change	Scarcity of Natural Resources
Malnutrition	Rise in Energy Consumption
Rise of Non-Communicable Diseases	Industry 4.0 – Digitization
Urbanisation	Big Data Analysis
Demographic Change	Economic Globalisation
Migration.	

These megatrends have been specified for their impact on agriculture and the food industry in the EU. For this, the Fit4Food2030 project distinguished the following categories: Agricultural production; Food processing; Consumer trends; Market economy, Retail and logistics; Packaging and waste; Policy and other trends. These categories included specific trends. (For an overview of all trends identified in the project Fit4Food2030, see Wepner *et al*., 2018).

In the FIELDS project, trends were specified for the four dimensions of the FIELDS project: sustainability, bio-economy, digitalisation and management/entrepreneurship and soft skills (business models). This was done jointly with an extensive analysis of the literature and sector and policy documents in the four dimensions of our FIELDS project, for the agriculture, forestry and food industry sectors. These steps led to the identification of main trends relevant to the FIELDS project. Table 2 gives an overview of identified trends in agriculture, forestry and the food industry grouped into the categories Sustainable production, Bio-economy, Digitalisation, and Business models. (see for the detailed literature analysis: Trienekens et al., 2021).

Table 2.

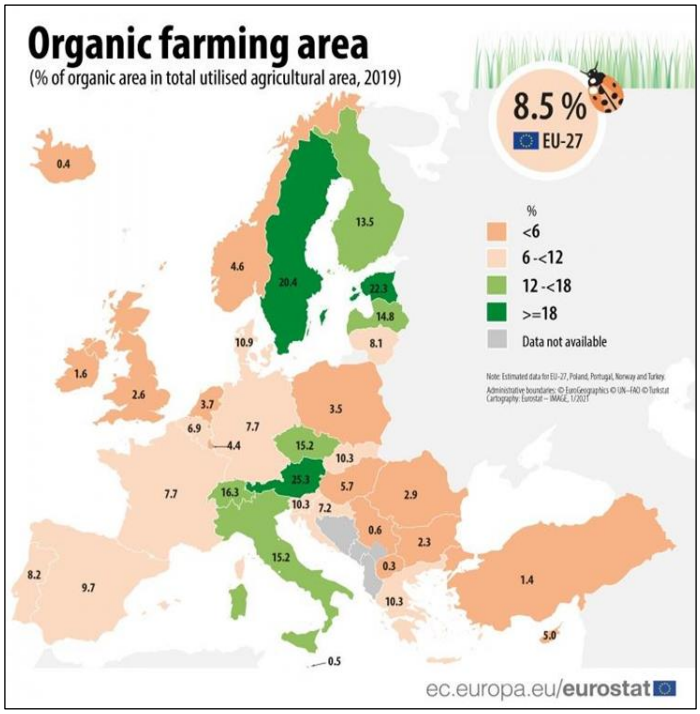
Identified trends in agriculture, forestry and the food industry in Europe (Trienekens et al., 2021).

Identified trends in Agriculture, Food industry and Forestry	
Sustainability	**Agriculture:** Integrated pest management, Integrated nutrient management, Agriculture pollution and GHG emissions, Organic farming and extensive production systems, Animal welfare, Scarcity of natural resources (land, nutrients), Pressure on water resources, Biodiversity and conservation of eco-systems, Food waste and loss **Forestry:** Large scale forest disturbances (droughts, heat waves, etc.), Impact of climate change on tree species and biomass characteristics, Biodiversity challenges, Illegal logging, Fragmentation of ownership, Health and safety challenges **Food Industry:** Technologies to deal with food waste and loss, Circular production, Energy efficiency, Environmental footprint, Smart logistics systems, Clean and ''green'' label, Consumer diets
Bio-economy	**Agriculture:** Biomass production and transformation, Renewable energy, Biobased products, Resource-efficient technologies and reduction of losses, Circularity of production, Biodiversity **Forestry:** Biomass production and transformation, Renewable energy, Biobased products and eco-system services, Increasing demands for wood, Urban green spaces/forests **Food Industry:** Use of food waste, Circular production, Energy efficiency, Biomass transformation, Bio-based products, Bio-based packaging, New proteins
Digitalisation	**Agriculture:** On-farm applications (combined technologies), Integrated FMIS, Big Data analysis and Agriculture 4.0, Traceability of produce, Supply Chain information systems, New customer relationships **Forestry:** In-forest applications (combined technologies), Mechanised harvesting, Timber transport and traceability, Forestry management information systems **Food Industry:** Food processing control, Food supply-chain monitoring, Factory design and industry 4.0, Robotics, Digital twins and augmented reality, 3D Printing/additive manufacturing, New technologies in processing and packaging,
Business Models	**Agriculture:** Changes in farm structure, Multi-functional farms, Urban farming and Indoor cultivation systems, Health and food consciousness of consumers, Traceability, Short food supply chains and Local/regional products, **Forestry:** Economic importance of forests, Urban green spaces, Fragmented ownerships, Lack of forest entrepreneurships, Weak infrastructure and technology **Food industry:** Complex consumer demands and new diets, Interaction with consumers, New logistics and e-commerce, Short food supply chains, Novel foods, New packaging

2.1 Country differences in trends

One finding of the trends analysis was that inter-country differences in the dimensions of our study are huge. We will discuss some key differences in trends in sustainability, bio-economy, digitalisation and business models at country level. Moreover, trends in the Agricultural Knowledge and Information System (AKIS) are included in the analyses (Geerling-Eiff, 2019; EU Scar AKIS, 2019). Insight in the AKIS on country level is essential for the development of new education and training tools, as in the implementation these tools have to be embedded in the AKIS of the respective country. Seven country trend studies were performed. The full country reports including literature reviews are included in (Trienekens et al., 2021).

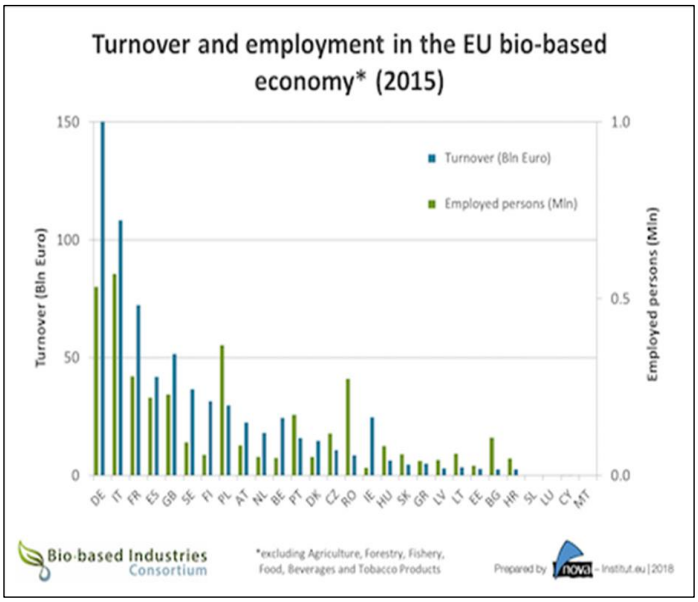
The differences between countries are dependent on key country characteristics such as digital infrastructure, level of sustainable production, farm/company structure, industry developments, level of education, etc. We will discuss these differences by giving one example/indicator for every of the dimensions of this study and present some key findings of the country analyses.



One of the key objectives of the European Green Deal is the achievement of 25% of the agricultural area in every country dedicated to organic production. For the dimension Sustainability, we present the share of organic farming per country as an indicator in Figure 2.

The figure clearly shows a leading position in organic production for Austria, followed by Italy and Finland, and thereafter Spain and France. The Netherlands and Ireland present a relatively low share of organic farming. However, Figure 3 depicts only one indicator for sustainable production. As found in the country studies, for example agriculture in Ireland is largely based on (sustainable) grass-based cattle farming, while Italy and France, like many of the other countries, struggle with agricultural emissions and the use of pesticides. Spain encounters severe water and irrigation-related issues, while Austria has forestry challenges (pests) related to climate change.

Figure 2. Share of organic farming per country in Europe (Eurostat, 2019).

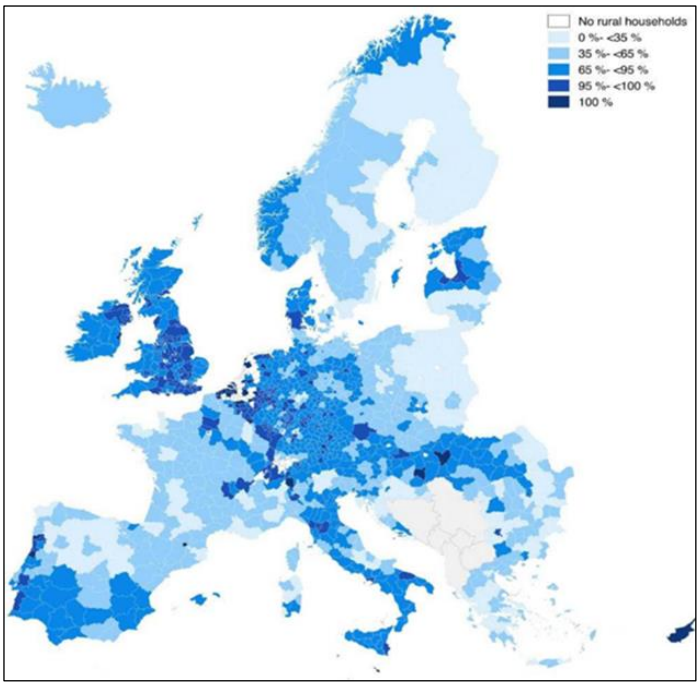


For the bio-economy dimension we present turnover and employment in the EU bio-based economy (Figure 3).

According to our country studies all countries are in a process of fast development of bio-based industries, except for Spain where the sector seems to be lagging behind. Austria, Finland, France, Italy and Spain are competent in wood-based products, constructions with wood (e.g. Austria) and in the use of wood biomass for renewable energy production. Bio-based products and energy production from agriculture are also fast developing in most countries, in particular in Italy, France, The Netherlands. The attempts to reduce food waste are best illustrated by the French Law against food waste, which forbids the disposal of food waste, by the larger food operators.

Figure 3. Turnover and employment in the EU biobased sector (BBI.Europe.eu).

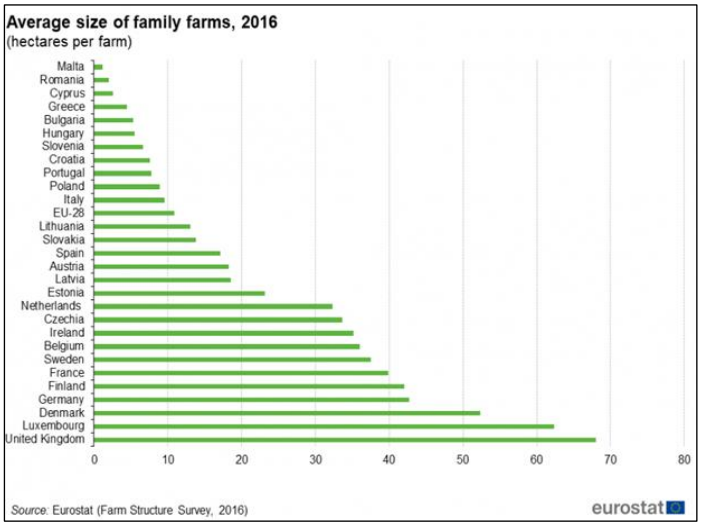
On digitalisation, the status and trend in the use of digital technologies in agriculture, forestry and the food industry were investigated on EU and on country level. As an example for the different levels of development in the EU figure 4 depicts broadband coverage throughout Europe.



Although all selected countries invest highly in digitalisation and public private collaboration therein, also stimulated by the EU Commission, the current broadband coverage can be a constraint for digitalisation in several regions in Europe. For the selected countries this, in particular, holds for France and Spain (see Figure 4).

The Dutch agricultural sector (e.g. dairy, horticulture) already has a strong history in digital technologies, related to its intensive farming systems. But also Austria, Italy and Finland are innovative in this area, although the structure of the agricultural sector in, for example, Austria with its many small farms, constraints the application of digital technologies.

Figure 4. Rural broadband coverage in Europe, 2019 (DESI, 2020).



For the business model dimension we present the differences in farm size in European countries. Figure 5 shows the average family farm size in Europe. According to our country studies the number of farms in the selected countries is decreasing fast, except for Ireland where the number of farms is relatively stable. At the same time, the size of the remaining, most family, farms increases. Farmers become entrepreneurs and multifunctional farming is growing fast, in particular in countries such as The Netherlands, Austria, France and Italy. Moreover, local-to-local chains are emerging in several countries like Austria, France, Italy and The Netherlands.

Figure 5. Average size of family farms, 2016 (Eurostat, 2016).

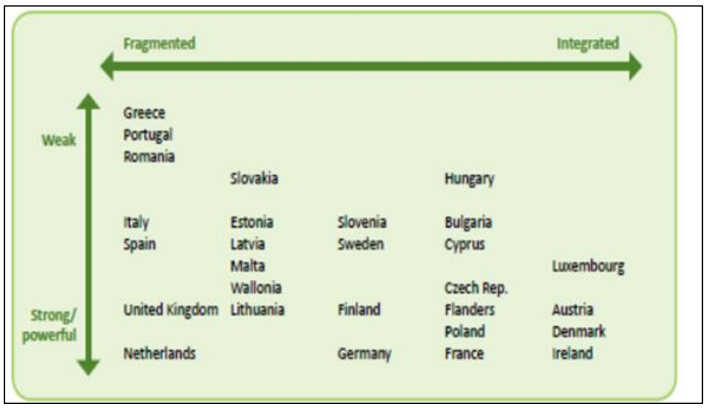


Figure 6 shows differences in the (agricultural knowledge and information system (AKIS) of European countries. The AKIS of most of the selected countries is considered strong, except for Italy and Spain. The structure of the AKIS is, however, quite different. Ireland and Austria have integrated and strong AKIS, while other countries like The Netherlands, Finland and France also have strong, but more fragmented AKIS.

Figure 6. Diversity of European AKISs in 2014 (EU SKAR AKIS 2019).

These examples give a clear picture of the inter-country differences in the EU on the dimensions of our study. The next section goes into skill needs of agriculture, the food industry and forestry sectors on the different dimensions.

3 Specification of skill needs

For the identification of skill needs in the areas Sustainability, Bio-economy, Digitalisation and Management/Entrepreneurship and soft skills FIELDS partners organised, from May to July 2020, nine national focus groups (in Italy, Ireland, Spain-Portugal, Netherlands, Austria, Germany, Greece, France and Slovenia) and two pan-European focus groups on EU policy and on forestry issues. The participants of each of the national focus groups were composed of at least 5 out of 8 predetermined stakeholder profiles: Farmers, Cooperatives, Agri-food companies, Education providers, Advisors, Foresters, Forest industries and Other. For the policy focus group and the forestry focus group, this composition was not mandatory.

Key topics in the focus group discussion were:

- Identified needs in agriculture, food industry and forestry.
- Existing training in response to identified needs, and missing training for the identified needs.
- Identified target groups for training and curricula definition.
- Best methods to deliver training to each target group.

In all of the national focus groups, participants had received 5 skills long lists on sustainability, digitalization, bioeconomy, soft skills; and business-entrepreneurship (each list containing 25 skills) beforehand and were asked to select and rank in order of importance on each of the 5 skills lists, the 5 most important skills for the sector they represent (e.g. farmer, forester, food industry etc.). Consequently, participants were asked to consider their selections and rankings and select among all 25 selected skills, the 10 overall so-called "most important skills" and rank them in order of importance.

Figure 7 shows the most important skills as identified by the focus groups at European level as well as the number of times the skill was identified as a top 10 skill. The most selected skill was *business planning /model and strategic management* followed by two skills related to communication: e*veryday usage of digital technology to communicate* and *communication* (both the same number of selections).''

Figure 7. the most important skills as identified in focus group discussions at European level.

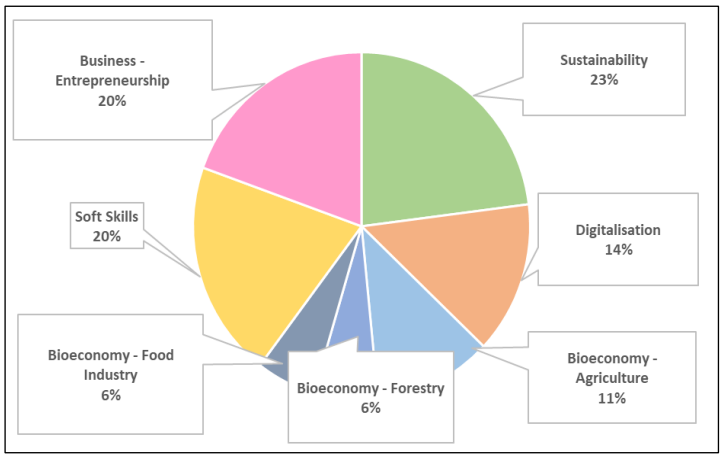


Figure 8 presents the division of selected key skills over the different dimensions, where the bio-economy dimension is divided in three sub groups and where also business-entrepreneurship and soft skills are considered separately.

The figure stresses the importance of business-entrepreneurship and soft skills, together making op 40% of the key skills as selected by the focus groups.

The importance of business-entrepreneurship skills was underlined in all focus groups. Farmers as well as food industry as well as forestry employees.

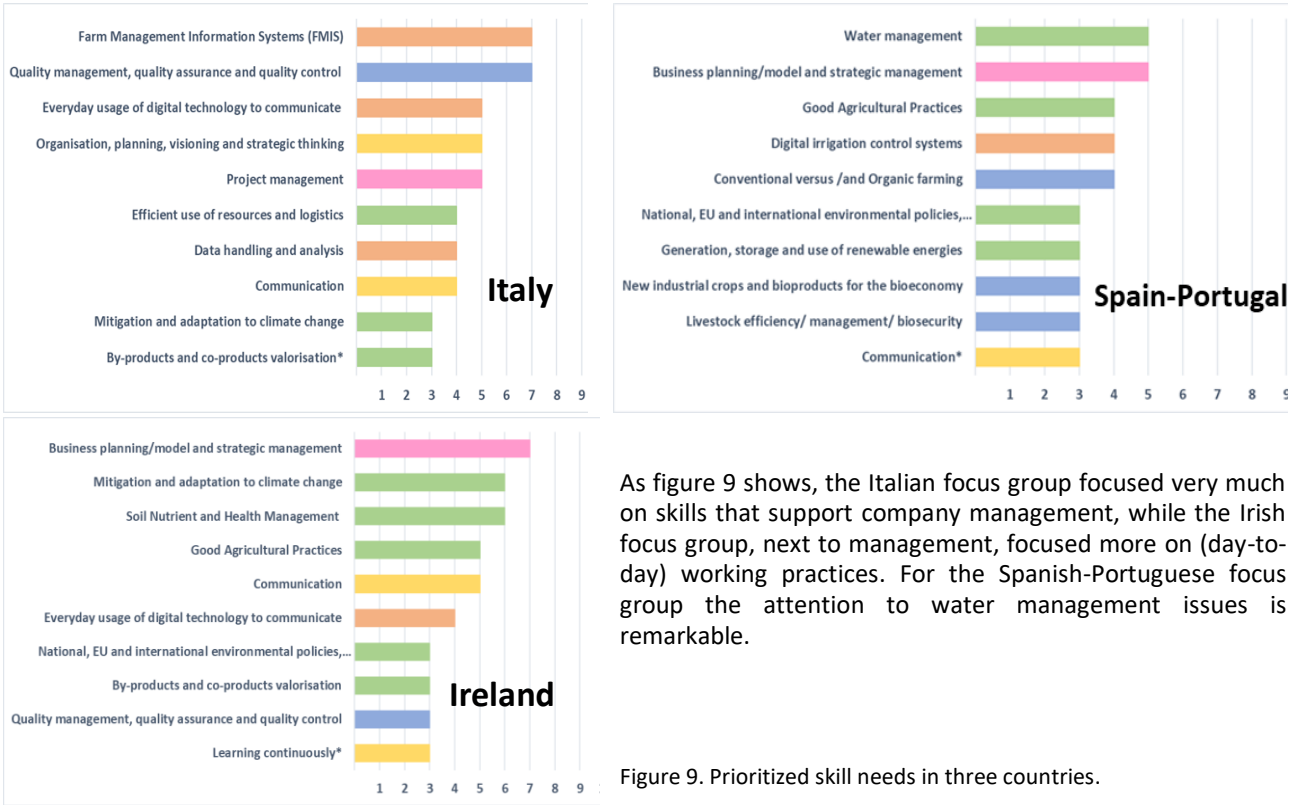
Figure 8. Distribution of skills among the categories.

As figure 7 shows, the most selected skill among all focus groups is business planning and strategic management. Everyday usage of digital technology to communicate (digital skill) and communication (soft skill) reached the same number of selections, which shows that the ability to use digital technologies as a means to communicate and the ability to communicate overall was seen as a fundamental skill in transferring information to others.

There was general agreement about the need to share knowledge and skills across different responsibility levels in the organisation. Moreover, different levels or different positions in the supply chain have to understand the necessity of skills at other levels of responsibility in order to create a mutual support for people at different jobs and job levels.

Considering different types of stakeholders, business planning and strategic management and communication, everyday usage of digital technology to communicate are all skills of key importance among farmers, cooperatives and also food industries. For the forestry focus group, the sustainability skills and bioeconomy skills specific for the forestry sector were predominant.

As country differences in the sector structure, level of technology development, national policies, education levels etc. in Europe are huge, the results of the skills need analysis differed between countries/ focus groups. Below three country level focus group outcomes on key skill needs are presented.



As figure 9 shows, the Italian focus group focused very much on skills that support company management, while the Irish focus group, next to management, focused more on (day-to-day) working practices. For the Spanish-Portuguese focus group the attention to water management issues is remarkable.

Figure 9. Prioritized skill needs in three countries.

4 Challenges and prerequisites for a European strategy

Based on the trend analysis and the skill needs as identified in the focus group discussions, a further investigation of challenges and prerequisites of a European strategy for agriculture, food industry and forestry skills was undertaken. For the identification of the challenges and prerequisites a questionnaire survey has been carried out among key stakeholders of the agri-food and forestry skills ecosystem.

The questionnaire included the following topics:

- Prerequisites for the development of training programs
- Harmonization challenges in the European agri-food and forestry skills ecosystem
- Monitoring and key performance indicators the European agri-food and forestry skills ecosystem
- Partnership and governance of the European agri-food and forestry skills ecosystem

The selection of these topics was based on EU policy documents (DigCompEdu, 2021; EU, 2021c/2021d; EU, 2018; Cedefop, 2020; EU/EACEA/Eurydice, 2016; EU, 2021e; EU, 2020) and reports of EU level organizations involved in the analysis of skill needs and/or the design of training (Effat/FDE, 2019/2020; EfVet, 2019; LLL, 2020 a/b/c; ILO, 2019). This information was complemented by a series with two-weekly discussions from april-october 2021 with FIELDS project partners. The questionnaire was semi-structured.

All stakeholders approached were partners of the FIELDS project, except for two forestry related respondents who were added to receive sufficient response for this sector. Respondents were asked to focus in their answers on one domain: agriculture, food industry, forestry. The questionnaire was sent out in the first week of October 2021, responses were received until mid-November 2021. 25 out of 30 stakeholders approached sent in their response: 14 focusing on the agriculture sector, 7 focusing on the food industry and 4 focusing on the forestry sector. The results of the survey were pre-discussed with a group of experts from agriculture and the food industry, and were qualitatively analysed. Answers were first grouped (in excel files) according to sector, job profile and key topic in the questionnaire. Subsequently further analysis was based on the key topics, sometimes rearranged or grouped if necessary. In the final analysis results from different sectors and research dimensions (e.g. sustainability, digitalisation) were combined, as for a number of topics no differences between sectors and/or research dimensions had been identified. When necessary, however, differences between sectors and/or research dimensions were articulated.

4.1 Key requirements for training programs

One of the questions in the questionnaire was to group skills in training modules. Results differed quite extensively across respondents, probably dependent on background and region of the responding organisation and on the skill needs considered most important by that respondent.

However, there were a number of key issues that respondents agreed upon.

A key position for management/entrepreneurship and soft skills

For the agriculture and food industry sectors several respondents stressed the importance of health and safety management, innovation management, (digital) entrepreneurship skills, critical and creative thinking, knowledge of agri-food communities, agro-tourism and local products. However, key attention was also given to relational skills, including staff networking and communication, negotiation, public speaking and English language, leadership and team management, food chain cooperation and interdisciplinary thinking.

Importance of training in practice

Working practices, working with real life problems, developing trouble-shooting skills are essential for most training programs. Further, there is a need for excursions (e.g. in agriculture to experimental farms), demonstrations and lectures by people with hands-on experience. Specifically for the food industries, respondents reported practical training required around food safety and quality management, production operations, bio-based functions, and working with automation and digital applications on industrial sites. However, sectorial differences should be taken into account in processes and equipment (conveyer belts, mixers, packaging etc.), as different skills may be required. For agriculture several areas of the sustainability and bio-economy dimensions were reported by the respondents as important in terms of practical experience, for example, waste prevention, soil health management and agro-environmental practices, production techniques for bio-based crops, industrial crops. Similar for forestry, digital skills and digital entrepreneurship, forest disease control and prevention, forest equipment/machinery and maintenance, and project management and business operations are important skills to be supported by practical experiences.

Next to these more technical skills, respondents in all three sectors underline the importance of practical experiences in communication skills, implying training of trainees in practical circumstances and supported by a company mentor. Moreover, working in a company implies collaboration with various staff functions, and not just working in and for one department (e.g. think of a lab function during a whole internship period).

The move towards online training

The Covid-19 pandemic has stimulated a further move towards online education at all levels of education. On the one hand this has led in the last two years to short term delays, as in particular practical exercises had to be postponed; on the other hand it has supported an ongoing trend towards online or blended (people are becoming ''zoom-tired'') education, in particular in these countries and regions with sufficient digital infrastructure provisions.

In general, for the more technical skills of the profiles on Bio-economy, Sustainability and Digitalisation, the basics can be taught online, however, advanced and applied knowledge/skills require in many cases practical training and real visits at factories, farms, forestry businesses. Moreover, new technologies like robotics and artificial intelligence, drones, cloud computing and block chain as well as developments around data protection (regulations) and data privacy will require new skills, which can partly taught online but also need practical experience.

Online training is supported through the fast development of tools, such as virtual reality applications, video intelligence, 3D animation, simulation tools (e.g. how to manage machines or production lines), etc. In general online courses are better accessible and are wider available than in-class courses. However, engagement is often lower while, in general, interaction between teacher and trainees remains essential for many of the subjects. Therefore, for most

modules a mixed approach is required. For these courses the 'flipped classroom'' approach can be applied, where online self-study and/or practice of students is combined with interactive classes.

For online training basic digital skills and equipment are necessary. At the start of a course or module, digitalisation skills of trainees should be measured, as simple as possible, according to the requirements of that specific course or module. Depending on the level of skills of the trainee supplementary courses should be offered. Customisation of educational procedures is a must in this regard, while training materials should be suited for a diverse EU population (language, culture, education level, urban-rural).

The right application of resources

Resources and in particular how to apply these are at the basis of any education and training program. This topic included questions on how to deal with lack of time and resources of potential trainees, how to raise interest for certain jobs and training and how to create ''inspiring learning environments''. The answers of the respondents resulted in a long list of ''tools'' that we grouped into four categories: timing, structure, communication and funding.

Table 3.
Timing, structure, communication and funding.

Timing • Schedule courses in off peak time (evening, weekends) or in hybrid mode. In general, adapt time schedules according to the availability of the trainees • Divide courses in short lessons (e.g. <= 1 hour) • Make modules/training courses complementary and diminish overlapping. • Design tailor-made fast tracks for business management
Program structure • Include social entrepreneurship as a topic to learn trainees a ''sustainability mindset'' with a long term vision on a sustainable bio-economy. • Include hands-on experience and use real life cases and applications, showing connections with the newest technology. Bring in fun! • Use technologies such as augmented reality and simulation; fascinating videos (e.g. of employees and of employers), game based resources, and online tools • Ensure that trainees serve in different departments during their traineeship so that they can get different experiences from different roles.
Communication • Define clearly your learning outcomes • Organize active promotion at education institutes and at agri-industry meetings and platforms. Combine with campaigns: online, press releases, newsletters, leaflets, weblinks, etc. • Emphasize the meaningfulness of jobs (the production of healthy, sustainable and high-quality food). • Modules and courses should be certified. Micro credentials should be offered, and trainees should receive formal certificates.
Funding • Provide e-learning for free, via e-learning platform (excl. a certificate) • EU programs, national funds and scholarships on competitive basis. • Financial support of companies (for employees), private corporate and public scholarships for internships, compensation of training time, or sabbatical like approaches. • Link subsidies to training certificate requirement (for example organic farmers need to follow a 5-day course to obtain subsidy

Attention to underprivileged groups and gender issues

Although, most respondents didn't recognize any gender issues in the areas discussed, in all day practice some functions are gender related. As one respondent stated ''.... forest management and wood science and technology are always believed to be fields of men''. In general, however, respondents report that gender should not play any role, therefore, existing European and national directives should be further put in place to overcome job inequalities between men and women.

In particular relatively few women do have a leadership role in the industry, which needs attention, both in (tailoring of) training modules as well as in life-long learning courses. For agriculture, respondents mentioned special attention needs for female farmers and for decision making functions at both farms and cooperatives. A special point mentioned regarding gender issues was the disadvantaged position of women after maternal leave. In line with this, reskilling of women who have been out of a job for years is a topic that needs attention.

Similarly, under-privileged groups and cultural diversity should remain a point of attention. In general under-privileged groups, low income workers and migrants might need financial support and support, through information and communication, to access courses. Next, labour mobility, migration and in particular seasonal harvest workers need extra attention in terms of language and adjustments in programs in terms of language and starting point.

4.2 Harmonization of VET systems

In section 2 (trends) we showed some key differences between countries in the EU, regarding level of technology development, attention to sustainable production, company structure etc. We also showed differences between the countries in the agricultural knowledge and information system (AKIS).

In line with these findings our respondents mentioned differences in job profiles and skill needs between countries, due to sector/industry differences, differences in business structure and company/farm size, differences in climate conditions, education levels, etc. Accordingly, programs are usually adapted to regional and local industries, with different definitions of job profiles. Moreover, different levels of knowledge and skills across countries and different competence levels of trainers are reported as one of the challenges for the harmonization of the system.

These differences put a lot of challenges for the establishment of a harmonized European strategy on skills:

- On a European policy level in 2020 the European skills agenda has been defined (European Skills Agenda, 2021). However, an implementation plan has yet to be developed and harmonisation challenges are large.
- Across Europe there are different regulatory systems and different funding systems. For example, Germany has a unique dual system structure of VET: combination of theoretical training in schools with practical training in companies. There is also a lack of best practices exchange between educational systems of different countries
- The European Qualification Framework (EQF) and National Qualifications frameworks (NQF) operate at different levels. For example, the EQF framework has 8 levels while the NQF framework in Ireland has 10 levels. Moreover, not all countries have a NQF with learning outcomes for each qualification
- An integral system of degree recognition in the EU doesn't exist.

4.3 Monitoring challenges at European level

One of the key issues identified by the respondents is the lack of an integrated European level monitoring system, to keep track of current and predict future skill needs and training demands, including labour mobility. The respondents mentioned specific challenges to achieve a European skills monitoring system are:

- The harmonisation of national education systems, as discussed above
- The identification of a common methodology for the definition of skill needs and monitoring these
- The inclusion of transversal/soft skills in the monitoring (transversal skills are not really evaluated in most countries)
- The commitment of member states and stakeholders to provide feedback
- Funding, design and maintenance of the infrastructure.

Many respondents are not aware of existing monitoring systems on European and on national level. In this regard several respondents consider identification of skill needs in the first place something that is done by companies in collaboration with education/training providers. However, others mentioned existing initiatives at different levels, see table 4.

Many respondents find that a self-sustaining supranational institute or governance mechanisms should be responsible for monitoring the European skills ecosystem, linking up with a network of education and training actors, SMEs, innovation actors and other stakeholders. Respondents proposed different ideas on the organisation to be responsible for design and maintenance of the European monitoring system, see table 5.

Table 4.
Skills monitoring activities in the EU

• EU-Eurostat, education and training statistics cover topics such as participation in education and training (including adult learning), learning mobility, education personnel, education finance, education and training outcomes, language learning and self-reported language skills. (https://ec.europa.eu/eurostat):
• EU Education and Training monitor (uses, among other things, Eurostat data) (https://ec.europa.eu/education/policy/strategic-framework/et-monitor_en)
• Eurydice provides information on education systems and policies in EU countries (https://eacea.ec.europa.eu/national-policies/eurydice/)
• CEDEFOP – skills intelligence - includes data from the European skills and jobs survey, CEDEFOP skills forecast data, data on skills in online job advertisements. https://www.cedefop.europa.eu/en/tools/skills-intelligence
• OECD keeps track of data on Outcomes of educational institutions (education Impact), Participation and progress (access to education), Investment in education (financial resources), Teachers and school organisations (learning environment). https://www.oecd.org/education
• Further on EU project level monitoring activities are done (e.g. https://www.askfood-observatory.net/), and, there are a number of smaller national initiatives, such as sector organisations and semi-governmental institutes.

Table 5.
Organisations responsible for a European monitoring system according respondents

- DG EAC, DG EMPL, DG GROW in collaboration with national (education/training) ministries and education and training institutes
- EU institutions and sector organizations involved in job market, skills and training needs analysis, including EIT, ESCO, CEDEFOP, EQAVET, EQAS, FDE, Copa-Cogeca, ...
- Agri-food Pact for Skills
- The Erasmus+ program, supported by stakeholders, and including, for example, a bi-annual European agri-food skills conference
- A supra-national organization is **not** needed; actual needs are best monitored locally. Regional authorities and public employment agencies should have a key role in monitoring.

A platform of digital services supporting diagnosis and monitoring of the skills ecosystem is considered essential by several of the respondents. The platform should include a database of current and future skill needs, supported by big data analysis tools and forecasting techniques. The system/platform to be designed should be smart, user friendly, upgradeable, interoperable, and financially sustainable. Updating should be supported by major input from training centres (student/trainee surveys) and companies (employer surveys), while regional and sectoral authorities should cooperate in the monitoring.

Key performance indicators were defined at two levels, skills partnership (see table 6) and training programs and courses (see table 7).

Table 6.
Assessment of the skills partnership.

• Number of stakeholders actively involved
• Coverage of countries and regions, (sub-)sectors
• Visibility and awareness, public opinion, consumer opinion
• Best practice dissemination and willingness of partners to share information/knowledge
• Impact on training programs and interest for the training programs (number of interested participants)
• Employees actively interested in participating in Life-Long Learning
• Yearly growth rate of new courses
• Raised level of final degrees of food employees

Table 7.
Assessment of training programs and courses.

• Number of students, company employees in the course • Number or % of participants from underrepresented groups • Achievement of learning goals • Student evaluation of training content and method • Number of certificates achieved • Flexibility of programs (hours, ECTS, online/face-to-face, ...) • Renewal of programs (new elements added year to year) • Resources per program and course (human resources, financial, technology...) • Weight of virtual, augmented and connected reality in the training modules, % of audio visual learning vs class learning • Employment status of trainees after graduation, incl. job promotions • Trainees and employer job impact evaluation (better execution of tasks, increased salary, new employment,….)

5 Conclusions

Fast developments in the agri-food and forestry sectors as there are climate change, scarcity of resources, globalisation, environmental pollution and sustainability awareness of consumers worldwide imply farmers, industry and forestry workers to acquire new skills to cope with the challenges they are confronted with. In this paper we described main trends in sustainability, digitalisation, bio-economy and management and entrepreneurship and the main skill and training needs of the workers in these sectors. These ask for a European level skills strategy for the agri-food and forestry sectors, in line with the European Skills Agenda of the European Committee (EU, 2020). Main points of attention for this strategy and main conclusions in this paper are:

For the development of education and training programs the following requirements were defined:

- Standardization of training modules across Europe is difficult because of regional differences, target group differences, etc. Training standardisation possibilities should be investigated on the level of ''basic'' modules and/or courses.
- in the design of modules and courses specific attention should be paid to 1. timing (align the course schedule to the trainee's availability), 2. structure (the aim is learning for practice), 3. communication (on the benefits for the trainee), 4 funding (to enable participation financially).
- in management/entrepreneurship and soft/transversal skills training, besides general business planning and management skills key attention should be given to relational skills.
- working practices are essential for most training programs. This in particular holds for the more technical skills, although typical skills to communicate and collaborate with other functions also do need practical experience and guidance by company mentors.
- in the design of new courses an optimal balance between online education (e.g. flipped classroom), face-to-face education, and in-company practice should be strived for.
- besides the necessity to improve internet access and access to computer equipment across Europe basic digitalisation training courses should be developed throughout Europe.
- under-privileged groups, low-income workers and migrants might need financial support and advice to access training.
- gender issues should be pre-assessed, in particular in training for tasks that is considered ''masculine'' or 'feminine'', and in soft skills modules. Special attention must be paid to women job returnees (upskilling).

Harmonization of the agri-food and forestry skills ecosystem is desirable

A common European catalogue and repository of training courses/programs together with a system of micro credentials can be a way to go, linked to national catalogues to define specific needs and aligned with a harmonized certification system for VET courses and programs and VET providers. Agreement between public and private parties on the catalogue and certification system is essential, to co-create the new skills ecosystem and to unlock public and private funds.

A European level agri-food skills and forestry skills monitoring infrastructure is lacking

Because of the diversity in the agri-food and forestry skills ecosystem across and the rather scattered and incomplete monitoring initiatives, a supra-national institute or organisation could (should) be responsible for design and

maintenance of a European monitoring infrastructure for skills. The system should take regional and sectoral differences into account and be smart, user friendly, upgradeable and interoperable. The many examples of monitoring systems working on national and multi-national level can be the starting point of the development of a European skill monitoring infrastructure.

KPIs are needed for ongoing assessment of the skill partnerships (Pact for Skills) and for assessment of training programs and courses. KPIs can be used for monitoring progress and outcomes and to take decisions on the way to go forward. A system of KPIs should be limited in complexity, and be transparent and user friendly.

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