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IDENTIFYING TECHNOLOGICAL CHANGES AND SKILL NEEDS IN THE WESTERN BALKAN AGRI-FOOD SECTOR

Cross-country report

CONTENTS

Introduction

This report presents a cross-country analysis conducted on the current and emerging technological changes and skill needs of small and medium-sized companies operating as part of the agri-food value chain in the Western Balkan countries: Albania, Bosnia and Herzegovina (BiH), Kosovo,[1] Montenegro, North Macedonia and Serbia.

The study focused on the following three specific agri-food value chain **niches** identified by the ETF:

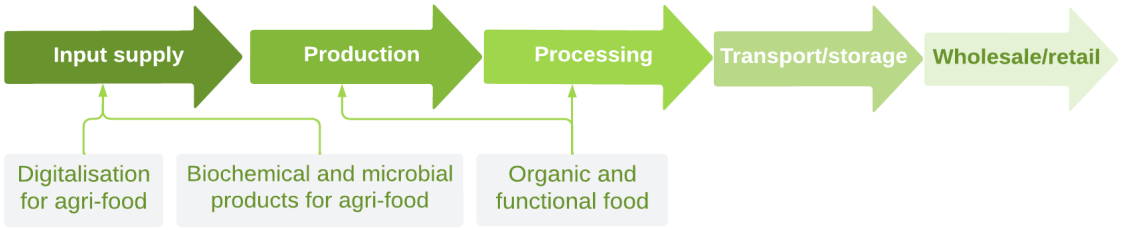
- the development and production of digital solutions for agri-food,
- the development and production of biochemical and microbial products for agri-food, and
- the production of organic food.

The main questions explored in this report are the following:

- What are the main characteristics and technology trends in agri-food and the selected agri-food niches in the Western Balkans countries?
- What are the current and emerging skill demands in agri-food and the specific market niches?
- How well does the existing education and training provision – including formal and non-formal training, support to companies and other activities – respond to the current and emerging skill needs?

As the study covers a novel area not investigated in the same scope before, the specific value chain niches require an introduction. Generally, the agri-food value chain can be understood as a series of consecutive steps, culminating in food consumption, moving from production and supply of inputs for the food production process (e.g. machinery, seeds, fertilisers, etc.) to sales and catering (see Figure 1). The study focuses on several specific steps in this chain. Companies of the biochemical and microbial products' niche, and the digital solutions for the agri-food niche can be seen as suppliers of inputs within the agri-food value chain. Both the microbial products' niche and the agri-food niche can be also understood as operating in the business-to-business (B2B) segment. At the same time, companies specialising in organic foods operate in the food production and food processing levels. Consumers are the end users of the products of this niche, and therefore companies operating in it should be seen as part of the business-to-consumer (B2) segment.

Figure 1. Agri-food value chain and the selected Western Balkan companies



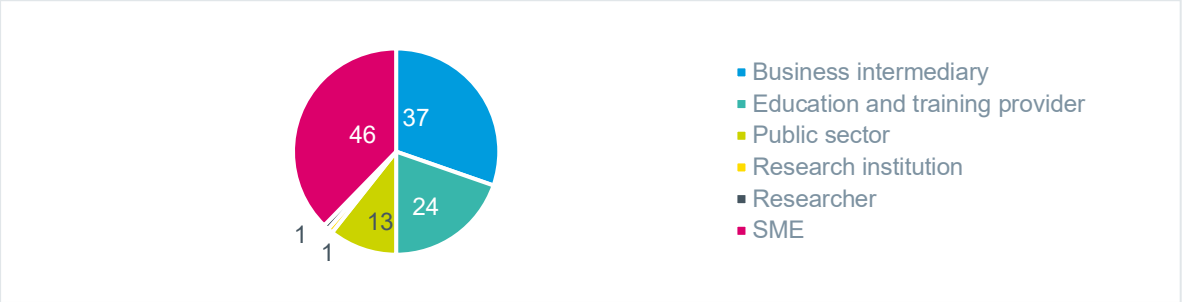
The niche definition and selection were based on a Call for participation launched by the ETF. In total, 19 enterprises were selected within the initial call in 2022. After analysing the activities and markets, they were grouped into the three niches that were defined for the purposes of this assignment. While they are not reflected in the traditional classifications of economic activities (i.e. NACE), the research team has mapped the broader sectors under which the activities implemented by these companies fall (they are referenced throughout the report). On that basis, additional companies, were identified during the research.

The analysis presented in this report is based on the analysis of the available statistical data, desk research and 127 interviews. Of the total number of interviews, 113 were implemented in the Western

[1] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

Balkan countries, with several groups of stakeholders, including companies active in the three market niches, public authorities, business intermediary bodies (e.g. chambers of commerce, trade unions, and business development agencies), and education and training providers (see Figure 2 below). Additionally, data on trends in agri-food in the EU in the three niches were gathered from 14 interviews with EU-based stakeholders, including associations, digital innovation hubs, and research institutions. This qualitative information was analysed together with the available national statistics and information from desk research. The detailed study methodology and interviewee list is provided in Annex 1. Methodology.

Figure 2. Interviewees in the Western Balkans



The report contributes to knowledge on skill development within the three selected niches within the Western Balkan agri-food value chain, and the challenges in satisfying the evolving demand for skills driven by technological changes, digitalisation, greening, internationalisation, and competitiveness. This insight is especially relevant in the broader context of the Smart Specialisation approach that the six economies of the Western Balkan region have adopted.

The agri-food sector has been identified as a priority area for economic growth in most of the Western Balkan economies.[2] Agri-food also remains one of the most important sectors globally, and fundamental to face the challenge of food security in the upcoming years. These challenges concern productivity, regional disparities, climate change and, more recently, Russia's invasion of Ukraine.[3] Innovation in the agri-food sector and its value chains, and the development of relevant skills are also essential for achieving the Sustainable Development Goals (SDGs), as set out in the United Nations' 2030 Agenda for Sustainable Development.[4]

Skills and their development, play a major role in implementing smart specialisation strategies. Across the EU and beyond, the stakeholder process to identify and prioritise public investments within the smart specialisation approach, the Entrepreneurial Discovery Process (EDP), has highlighted skills' shortages and mismatches as an important challenge. The increased use of new technologies and greening is exacerbating the skill challenges for companies operating in priority areas for smart specialisation. Changing the labour market requirements is making cross-sectoral higher vocational skills essential in innovation ecosystems.

Within this context, the report provides insight on the main research questions. The next section provides a general overview of agri-food production in the Western Balkans. Furthermore, the report focuses on each of the three market niches individually. A separate section is dedicated to each niche to provide an overview of the Western Balkan context, and for comparison with the EU situation. The

[2] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here; Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here; Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here; Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here; No smart specialisation documents were available for Bosnia and Herzegovina.

[2] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.

[3] European Commission (2022). Agri-food Data Portal. Available here.

[4] Focus on the agri-food sector is most directly related to SDG2, as well as SDG 6, SDG 9, SDG 12, SDG 15. Focus on skills development also concerns SDG 4 and SDG 8. More information on SDG is available here.

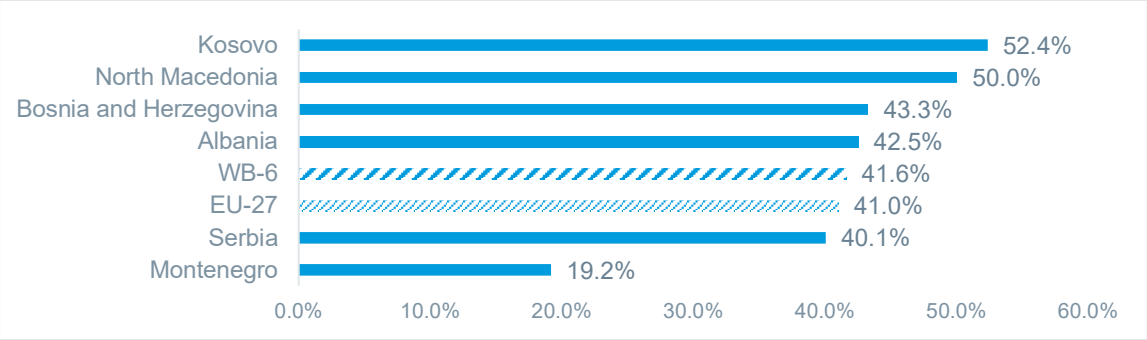
skill supply and demand situation in each niche market is analysed thereafter. Finally, in the Conclusions the findings are summarised.

Overview of the agri-food sector in Western Balkans

The agri-food industry makes up a significant part of the Western Balkan economies. It is one of the focus areas of the export specialisation and innovation activities, and has prospects for strengthening regional innovation and technology diffusion.

To begin with, despite some cross-national variation, several of the Western Balkan economies have high agricultural potential, with 41.6% of the land area in the region being agricultural land, which is similar to that of the EU (41%) (Figure 3).

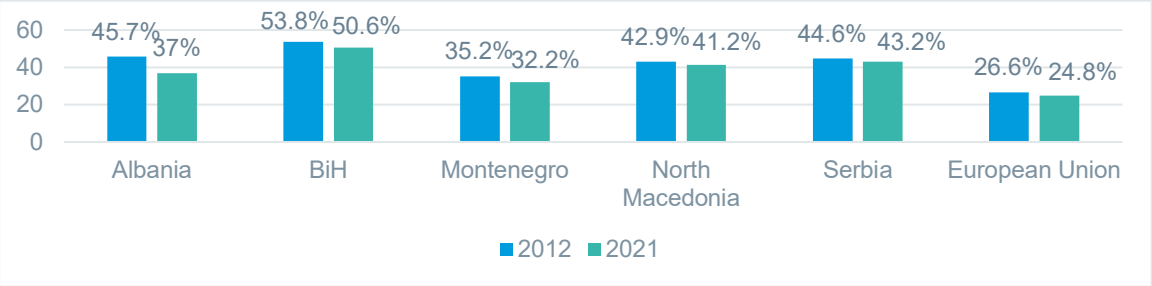
Figure 3. Agricultural land (% of land area), 2020



Source: based on the World Bank data.

Furthermore, a large share of the Western Balkan population lives in rural areas (see Figure 4). Even though the share has been decreasing in the past 10 years in all the economies (most notably in Albania), it remains considerably higher than in the EU.

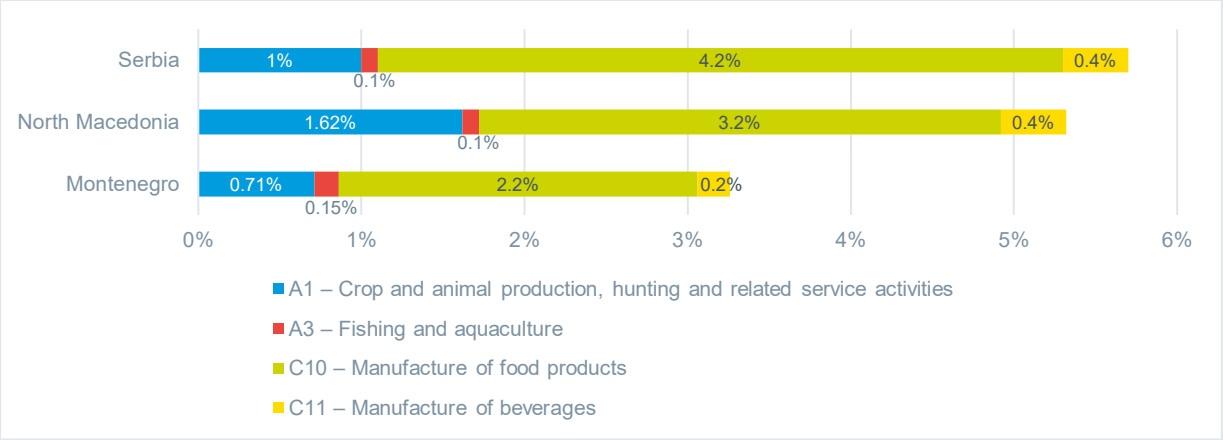
Figure 4. Rural population (% of total population)



Source: World Bank data.

The agri-food sector is also a considerable source of employment opportunities in the region. Agriculture, fishing, and food and beverage processing provided employment for nearly 6% of the employed in Serbia, around 5% in North Macedonia, and 3% in Montenegro in 2021, according to the registered employment data (see Figure 5). Unfortunately, no comparable information is available for the other three Western Balkan economies.

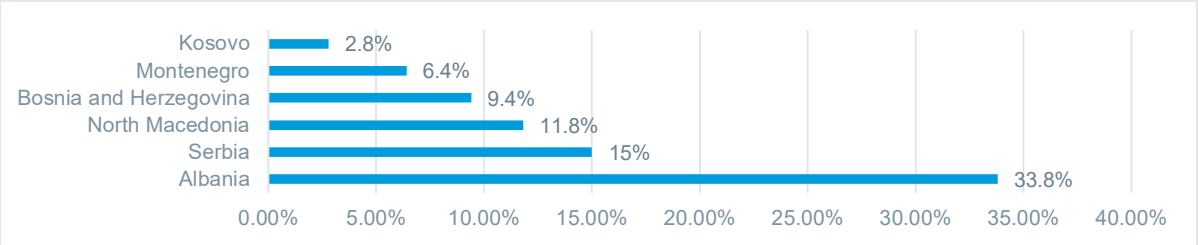
*Figure 5. Employees in A1, A3, C10 and C11 sectors as a share of total employment, registered employment data, 2021**



Source: statistical yearbooks of Montenegro, North Macedonia and Serbia. *Data for North Macedonia is presented for 2020 due to data availability.

However, due to the high levels of informality in the agriculture sector, the actual share of agriculture in the overall employment is likely to be much higher, as somewhat indicated by the LFS data (see Figure 6). In Albania, formal employment in agriculture, forestry and fisheries (A1) sector reaches almost 34%, followed by Serbia (15%) and North Macedonia (nearly 12%). Some of the existing sources estimate that in Albania and Serbia, informal workers account for about two-thirds of all workers in agriculture. Meanwhile, in Bosnia and Herzegovina and Montenegro these figures can reach 90%.[5]

Figure 6. The share of employment in agriculture, forestry and fisheries, LFS, 2021

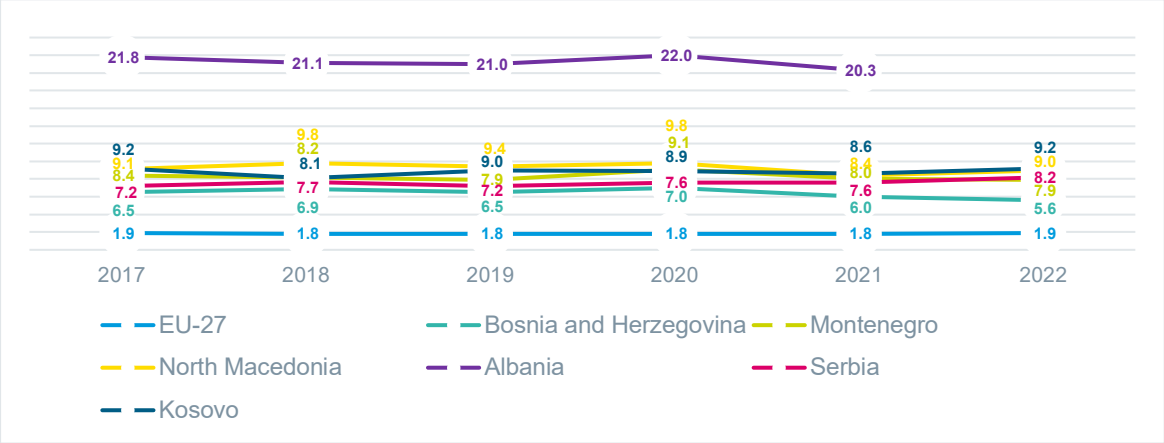


Source: National statistics offices of Albania, BiH, Kosovo, Montenegro, North Macedonia and Serbia.

Agriculture is an important sector for the Western Balkan economic performance: in 2021, together with forestry and fishing, it contributed to 9.6% of the GDP on average, compared to 1.8% in the EU. Between 2017 and 2022, the share of agriculture, forestry and fishing in the total gross value added remained relatively stable in the EU and in the Western Balkan region with some fluctuations (see Figure 7).

[5] Bartlett, W., Oruc, N. (2021), Labour Markets in the Western Balkans 2019 and 2020. Regional Cooperation Council.

Figure 7. Gross value added: share of agriculture, forestry and fishing, % of total, 2017-2022



Source: Based on Eurostat, [nama_10_a10]

Note: provisional values are used for Kosovo, Montenegro, North Macedonia, and Serbia.

Smaller farms of up to 5 ha in size are predominant in the Western Balkans and in the EU. At the same time, the share of big farms (>20ha) is considerably larger in the EU than in the Western Balkan economies, as illustrated in the table below.

Table 1. Farms by size, in % of total farms

Farm size/ country	Kosovo	Montenegro	North Macedonia	Serbia	EU
<0.5 ha	22.7%	28.5%	41.5%	6.3%	
0.5 ha < 1 ha	18.4%	13.3%	19.3%	12.8%	
1 ha < 5 ha	45.4%	35.1%	34.5%	52.4%	63.8%
5 ha < 10 ha	8.3%	10.8%	3.2%	17.2%	12.4%
10 ha < 20 ha	3.2%	6.0%		7.3%	8.7%
20 ha < 30 ha	0.9%	2.3%		2.0%	3.8%
30 ha < 50 ha		2.1%		1.1%	3.9%
50ha <100 ha		1.3%		0.7%	3.9%
>100 ha	1.1%	0.7%	1.5%	0.3%	3.6%
Total	**129884**	**43791**	**178124**	**559252**	**9067310**

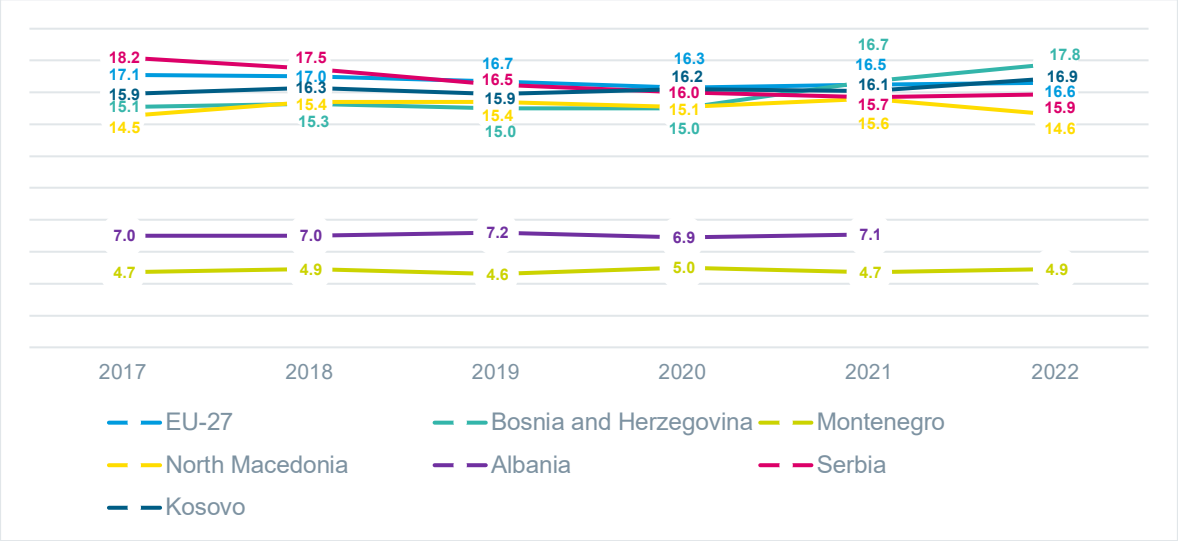
Source: National statistics offices of Kosovo, Montenegro, North Macedonia, and Serbia; Eurostat.
Note: data is presented for the following years: Kosovo – 2014, Montenegro – 2016, North Macedonia – 2016, Serbia – 2018, EU – 2020.

No comparable data exist for the food processing sector. Compared to agriculture, forestry and fisheries, the importance of the manufacturing sector as a whole (NACE C) in terms of gross value added was much lower in Albania and Montenegro, and higher in Bosnia and Herzegovina, Kosovo, North Macedonia and Serbia, as well as in the EU (see Figure 8).

Furthermore, some of the existing data indicate that in most of the Western Balkan economies, the production of food and beverages is the biggest sector in the manufacturing industry, and its share of the total manufacturing output ranged from 20% in Bosnia and Herzegovina to 32% in Montenegro in 2019.[6]

[6] UNIDO Statistics Data Portal (2019). Manufacturing Composition 2019. Available here.

Figure 8. Gross value added: share of the manufacturing sector, % of total, 2017-2022



Source: Based on Eurostat, [nama_10_a10]

Note: Eurostat only provides provisional values for Kosovo, Montenegro, North Macedonia, and Serbia.

The contribution of the food and beverage production sectors to the overall national GDP is also considerable. For instance, in Serbia, a leader in agri-food exports in the region, the food processing industry contributes with about 2.8% in the creation of the national GDP, of which 2.3% refers to manufacture of food products, and the remaining 0.5% to the production and processing of beverages.[7]

Disaggregated data on the size of businesses in food and beverages production sectors were only available for Serbia (see the figure below). In 2020, the vast majority of businesses in the manufacture of food products (NACE C10) sector and manufacture of beverages (NACE C11) sector were SMEs, dominated by micro-sized enterprises (up to 9 employees).

Figure 9. Enterprises by size in Serbia, NACE C10-11, 2020

Source: Statistical Office of Serbia. Available here.

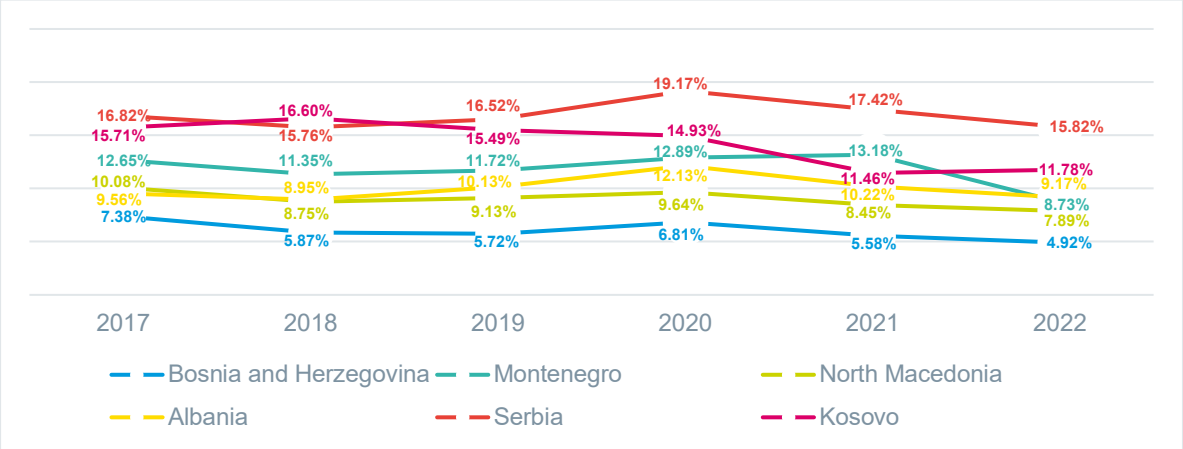
Looking into the trade statistics, on average, exports of food, drinks and tobacco constituted 13% of exports from Western Balkan economies, compared to 9% in the EU. Serbia is a major exporter of processed food and beverages (see Figure 10). However, most of the region's economies except for Serbia also have agri-food trade deficits (i.e. food imports exceed the exports), indicating the

[7] Statistical Office of the Republic of Serbia. (2022). *Statistical yearbook*. Belgrade: Statistical Office of the Republic of Serbia. Available here.

challenges to the overall competitive position of the region.[8] Research on the agri-food products' position in the international market also reveals an unfavourable export structure in the Western Balkan region, with a considerable percentage of exports being lower-processed products, and therefore are lower added value, crop products, such as fruits, vegetables, and cereals, while the share of livestock products is inadequate. To enhance competitiveness in the global market, support for technology adoption to improve production efficiency of SMEs is needed.

Trade agreements with the European Union (EU) and the 2006 Central European Free Trade Agreement (CEFTA)[9] have significantly influenced the liberalisation of trade in agri-food products in the Western Balkan economies.[10] In all Western Balkan economies, the trade of agri-food products has intensified and there has been an increase in exports. However, while the value of food and tobacco exports has been steadily increasing in the past years,[11] the share of these products in the total exports slightly decreased from 2017 to 2022 in all Western Balkan economies.

Figure 10. Exports of food, drinks and tobacco as a percentage of total exports, 2017-2021



Source: based on Eurostat [EXT_LT_INTERCC].

Note: Food, drinks and tobacco (SITC0_1) category includes Food and live animals (SITC_0) and Beverages and tobacco (SITC_1).

Recent studies show that all Western Balkan economies except Albania have comparative advantages in exporting agri-food products to the EU.[12] Serbia specifically was found to have the highest level of comparative advantages in this sector, followed by North Macedonia.[13] These economies not only demonstrate favourable agri-food trade balances, but also scientific potential and specialisation in agricultural and biological sciences with several institutions with a high reputation in the region (e.g. Serbia's BioSense Institute). Their existence indicates some potential to increase regional innovation, technology transfer and technology diffusion in both the public and the private sector to increase productivity in agri-food production – even though the innovation environment for it is still considered to be relatively weak at the regional level.[14] The agri-food sector also serves as a

[8] Based on Eurostat data on international trade. Available here. See also World Bank Group (2017). Agriculture for Jobs and Growth in the Western Balkans. Available here.
[9] Available here.
[10] Matkovski, B., Zekić, S., Đokić, D., Jurjević, Ž., & Đurić, I. (2021). Export competitiveness of agri-food sector during the EU integration process: Evidence from the Western Balkans. Foods, 11(1), 10.
[11] Based on Eurostat [EXT_LT_INTERCC] data. Available here.
[12] Matkovski, B., Zekić, S., Đokić, D., Jurjević, Ž., & Đurić, I. (2021). Export competitiveness of agri-food sector during the EU integration process: Evidence from the Western Balkans. Foods, 11(1), 10; Matusiak, M., Radovanovic, N., Rakhmatullin, R., Stehrer, R., Beraha, I., Berrer, H., Boch, M., Djuricin, S., Graser, G., Jovanovic, B., Korpar, N., Ljumovic, I. and Marjanovic, D., Analysis of Value Chains in the Western Balkan Economies - Enriching the Potential for Regional Cooperation in Priority Areas, Matusiak, M., Radovanovic, N. and Rakhmatullin, R. editor(s), EUR 31024 EN, Publications Office of the European Union, Luxembourg, 2022, ISBN 978-92-76-49489-8, doi:10.2760/47718, JRC126816.
[13] The authors used the revealed comparative advantages (RCA) index, one of the most commonly used indices in the literature on agri-food trade competitiveness.
[14] World Bank Group. (2018). Exploring the Potential of Agriculture in the Western Balkans: A Regional Report. World Bank.

basis for development of other sectors important for the region's economy, such as tourism, production of equipment, machinery and packaging, transport and other services.[15]

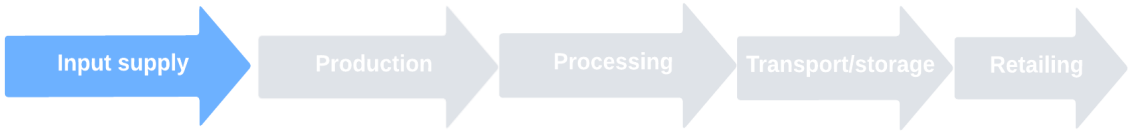
[15] Government of Montenegro (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.

Digitalisation for agri-food

Overview

In this section the focus is on the first of the three agri-food value chain niches, specifically the development and production of digital solutions for agri-food.[16] It operates on the input level of the agri-food value chain, as shown in Figure 11.

Figure 11. Digitalisation in the agri-food market niche within the agri-food value chain



The activities of digitalisation for agri-food can be defined under the following NACE sectors, to the extent that the companies in these sectors specialise in developing digital technologies for agri-food:

- Manufacture of agricultural and forestry machinery (C28.3).
- Manufacture of machinery for food, beverage, and tobacco processing (C28.9.3).
- Computer programming, consultancy and related activities (J62).
- Information and service activities (J63).
- Research and experimental development on natural sciences and engineering (M72.1).

It is a developing area of economic activity, with technologies such as Unmanned Aerial Vehicles (UAVs, or drones), e-commerce, crop patterns monitoring, the Internet of Things (IoT) and robotics applied in agri-food becoming more in demand worldwide. Such applications of digital technologies improve various aspects of the agri-food production, in particular its efficiency, productivity, and, consequently, competitiveness.

The development of digital technologies in the agri-food value chain is usually referred to as smart agriculture (SA) or agri-tech. The European Commission (EC) sees the digital innovation in agricultural holdings as an important driver for making the value chain more efficient in terms of production and more resilient to the impacts of climate change, as outlined, most recently, in the Farm to Fork (F2F) Strategy.[17] Digital technology innovations in agri-food can help improve levels of productivity of agricultural holdings by making production processes more precise and streamlined. It can also ease the process of meeting EU requirements related to the quality of food production and exporting for the Western Balkan economies.

In the EU, market research agencies predict the smart agriculture market to grow by 12% at a compound annual growth rate (CAGR) over the period of 2022-2030.[18] This indicates both the increasing adoption of digital technologies for agri-food in the EU and the need to facilitate cross-sectoral approaches to skills development between agriculture and ICT. Similar trends, although to a considerably smaller extent, seem to be emerging across the Western Balkan region.

The potential of digitalisation in agri-food has been noticed by the governments of the Western Balkan economies. For example:

- The 2020-2027 Smart Specialisation Strategy in Serbia identifies innovative food production practices as a priority for future growth and innovation in the economy.[19]

[16] It should be distinguished from *applications* of digital innovations in farms.
[17] European Commission (2020). Farm to Fork Strategy. Available here.
[18] Straits Research (2022). Europe Smart Agriculture Market. Available here.
[19] Government of the Republic of Serbia (2020). Smart Specialisation Strategy of the Republic of Serbia 2020-2027. Available here.

- In North Macedonia, the Strategy for Agricultural and Rural Development 2021-2027 stresses the development of precision agriculture and the use of digital solutions to reduce administrative burden and increase educational opportunities for agricultural workers.[20] In the mapping of priority areas for smart specialisation, 'Smart agriculture and food with higher added value' was identified as a potential priority area. [21]
- In Kosovo, digitalisation has been acknowledged as a means for increasing the competitiveness of the agri-food sector and improving the efficiency and sustainability of farm production.[22]
- Bosnia and Herzegovina's Economic Reform Programme 2023-2025 envisages actions to foster digitisation in agriculture, such as maintaining Agricultural Market Information System and upgrading agricultural registers and other information systems, including land parcel digitisation systems.[23]
- In Montenegro's smart specialisation strategy, ICT is seen as a horizontal priority to be integrated into various vertical priorities, including agriculture and food production.[24]
- Albania's Digital Agenda 2015-2020 identifies the digitalisation of agri-food as a priority and aims to encourage innovation in the sector.[25] Further development of the broadband infrastructure envisioned within Albania's Economic Reform Programme 2023-2025 is expected to increase the competitiveness of businesses and farmers in rural and remote areas.[26]

Nevertheless, smart specialisation strategies mostly focus on the application of digital technologies in agri-food rather than their development. Except for a few cases of digitising agricultural information and developing ICT access in rural areas, Economic Reform Programmes in the Western Balkan economies rarely mention digital solutions for agri-food.[27]

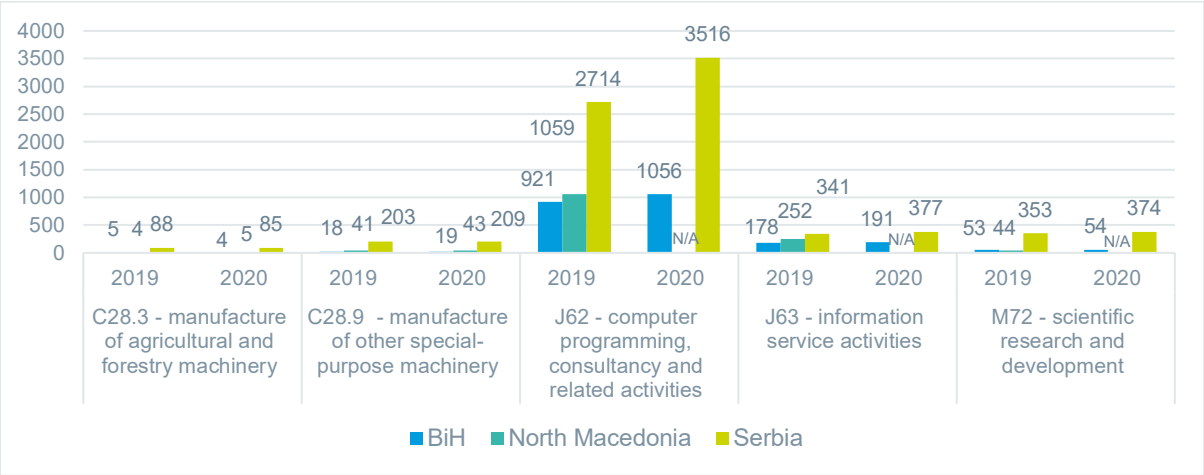
The activities relating to the development and production digitalisation solutions for agri-food in the Western Balkan region are few and small-scale compared to the EU. Although some start-ups specialising in developing digital technologies for agri-food solutions were found in several countries, overall, only a handful of very small companies were identified across the region. In terms of technology adoption in the region, even though some innovative farmers are applying digital innovations in their processes, those digital solutions are not necessarily developed domestically.

Statistics that could help to understand the scale of the activities in focus are scarce, as they are covered under several different NACE codes, without indicating which of them specialise in the development and production of digital innovations for agri-food (see Annex 1. Methodology). While no comparable statistics were available for Albania, Montenegro and Kosovo, the collected qualitative insights confirmed that there are very few companies in this niche in these economies. Overall, the sectors of economic activity, under which the relevant companies are likely to be classified, are the most populous in Serbia. The economy has considerably larger scale activities in all of these NACE

[20] IPARD North Macedonia (2021). National Strategy for Agricultural and Rural Development 2021-2027. Available here.
[21] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[22] Ministry of Agriculture, Forestry and Rural Development of Kosovo (2021). Strategy for Agriculture and Rural Development 2022-2028. Available here.
[23] BiH Directorate for Economic Planning (2023) Economic Reform Programme 2023-2025. Available here.
[24] The Government of Montenegro (2022). The Programme of Development of Agriculture and Rural Areas as part of the IPARD Framework 2021-2027. Available here. See also Ministry of Science of Montenegro (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[25] Ministry of Innovation and Public Administration (2015). Cross-Cutting Strategy 'Digital Agenda of Albania 2015-2020.' Available here.
[26] Republic of Albania Council of Ministers (2023). Economic Reform Programme 2023-2025. Available here.
[27] See Republic of Albania Council of Ministers (2023). Economic Reform Programme 2023-2025. Available here; BiH Directorate for Economic Planning (2023) Economic Reform Programme 2023-2025. Available here; Republic of Kosovo (2023). Economic Reform Programme 2023-2025. Available here; Government of Montenegro (2023). Economic Reform Programme 2023-2025. Available here; Republic of North Macedonia (2023). Economic Reform Programme 2023-2025. Available here; Ministry of Finance of Serbia (2023). Economic Reform Programme 2023-2025. Available here.

sectors, including in the manufacture of machinery, computer programming, as well as scientific research and development.

Figure 12. Numbers of companies from NACE sectors related to the digitalisation niche



Source: Eurostat (2022), [SBS_SC_SCA_R2]

Most of the companies engaged in digitalisation for agri-food activities that were interviewed in the Western Balkan region were start-ups and micro or small businesses. Most of them focused on the domestic markets for their products and services, and specifically business relating to food production rather than processing. Only some of the companies, based in Serbia and North Macedonia, exported their products and services, mainly to the EU. The interviewed enterprises from Serbia and North Macedonia, and (to a smaller extent) Kosovo and Montenegro specialise in developing AI, IoT, robotics, drones and Big Data solutions for agriculture. More specifically, these technologies include drone mapping, landscape robots, automated smart farm solutions for digital monitoring and controlling of farmlands, greenhouses, vineyards and irrigation processes, smart water dispensers for bees and fish feeding devices, as well as e-commerce platforms. In two Western Balkan economies, Albania and Bosnia and Herzegovina, no companies involved in the production of digital technologies for agri-food could be identified. While some development activities take place in Bosnia and Herzegovina, companies in Albania only engage in business data analytics and providing information for agribusinesses. Overall, the data collected at the level of individual economies show that Serbia, followed by North Macedonia, have the highest number of companies offering digital solutions for agri-food producers.

The development of the niche in Serbia benefits from international projects, such as the USAID-supported initiative 'Serbia Innovates' that runs until 2025[28] The project was started with the intention of creating four superclusters of innovation in areas with the biggest potential for fast and sustainable growth, one of which is digitalisation in agri-food. Superclusters of innovation engage SMEs, start-ups, investors, research institutes, institutes of higher education, and public authorities.

Serbia also has a lively stakeholder ecosystem to support the development of digitalisation activities for agri-food. The EU co-funded BioSense Institute (founded in 2015), for example, is a pioneer in digital transformation of agriculture in Serbia and the region more broadly. Besides its active contribution to developing digital innovations for agri-food, it collaborates with government, industry and research organisations to drive the digitalisation of agri-food.[29]

Similar research, innovation and networking ecosystems with a focus on digitalising agri-food are emerging also in some other Western Balkan economies, although still at a smaller scale.[30] For instance, in North Macedonia, the Fund for Innovation and Technological Development (FITD)

[28] Serbia Innovates. Available here.
[29] Biosense Institute. Available here.
[30] In BiH, the Smart Village Knežica digital innovation hub also focuses on digitalisation in agri-food, however, from the application point of view. That is, they aim to help agricultural holdings modernise rather than develop digital innovations.

financially supports innovative companies, including those that engage in developing and producing digitalisation solutions for agri-food. It also provides mentoring, support and networking opportunities for start-ups. In Bosnia and Herzegovina, Smart Village Knezica, although focused more on encouraging application of digital solutions for agri-food, is involved in R&D activities too. In Montenegro, the BIO-ICT Centre of Excellence (run by the Electrotechnical Faculty at the University of Montenegro) actively engages in research and innovation activities in agri-tech. It aims to boost the application and use of the latest ICT technologies in the areas of agriculture, marine biology and environmental monitoring, among others. Meanwhile, the Montenegrin Science and Innovation Park Technopolis was established to enable the generation and commercialisation of innovative ideas in a specific product or service, including in the agri-tech area. In Kosovo, the Association for Information and Communication Technology (STIKK) has a similar role of supporting innovative start-ups offering digital solutions.

Skill supply and demand

Employment profile

Looking into the broader NACE sectors under which the niche of digitalisation in agri-food operates, the available comparable statistical data on employment is incomplete. It does show, however, that in Montenegro, North Macedonia and Serbia, the relevant sectors contribute to small shares of the total employment (see Table 2). The same conclusions were drawn in the analysis of qualitative data on Albania, Kosovo and Bosnia and Herzegovina, although these economies not have no comparable data on the employed by occupation and education in the respective sub-sectors. Data on employment in these sectors by education are not available in the target countries.

Table 2. The share of employees in sectors relevant for the Digitalisation niche, Registered employment and LFS, 2021*

	Kosovo	*Montenegro*	*North Macedonia*	*Serbia*
Total employment	386,87*	188,964	602,722	2,212,631
C28 - Manufacture of machinery and equipment n.e.c.	N/A	0.12%	0.4%	0.76%
J - Information and Communication	3.2%*	3.3%	3%	3.74%
J62 - Computer, programming, consultancy and related activities	N/A	0.95%	1.52%	1.9%
J63 - Information service activities	N/A	0.18%	0.33%	0.23%
M - Professional, scientific and technical activities	3.18%*	5.57%	4.12%	5.22%
M72 - Scientific research and development	N/A	0.07%	0.12%	0.51%

Source: Statistical yearbooks of Montenegro, North Macedonia and Serbia; National statistics office of Kosovo.

The interviewed companies representing the niche were small employers, mostly with under 10 permanent employees hired locally (see Annex 2. Company profiles). The majority of them were managed by men. Most of the employees had university level education (i.e. ISCED 6), mainly in computer science and related fields (e.g. software development, frontend and backend programming, marketing, and sales).

The salaries in the niche which is largely covered by the ICT (NACE sector J) and professional and scientific activities (NACE sector M) sectors are high compared to the country averages, and especially in comparison with the salaries in the agri-food sector (see Table 3). Despite seemingly attractive wages, several companies in the niche that were looking for new employees were sometimes facing hiring difficulties – mostly linked to the shortage of necessary expertise, explained in the following sections.

Table 3. Average monthly income (net) in the Western Balkan region, disaggregated by economic activities (% of total average salary, EUR), 2021

Country	Albania	Bosnia and Herzegovina	Kosovo	Montenegro	North Macedonia	Serbia
Total average salary (EUR)	462	511	432	532	465	561
Agriculture, forestry and fishing (A)	65%	87%	62%	85%	80%	85%
Manufacturing (C)	86%	77%	78%	74%	85%	87%
Information and Communication (J)	147%	144%	155%	130%	192%	217%
Professional, scientific and technical activities (M)	109%	109%	106%	n/a	120%	129%

Note: All salaries are net. There were no data on net salaries for Albania, so we recalculated the gross by using the tool available on the website for the Albanian General Directorate for Taxes, available here. Data on most salaries were available only in national currencies. Salaries were converted to EUR using the exchange rates for February 2023.[31] After conversion of national currencies to EUR, we calculated the percentages for economic activities relative to the total average salary in the country.

Skill demand

Technical occupations and skills

In the interviews, when asked about their skill demand, the companies focused on and mentioned a variety of skills that they expect to see in their new and current employees. Several commonalities were identified across companies from different companies, engaged in the development of different technological solutions.

Most notably, specialists working at small and micro companies were expected to possess interdisciplinary technical profiles. Many of the interviewed companies and other stakeholders representing the digitalisation solutions for the **agri-food market niche in the Western Balkans strongly emphasised or implied skillsets that exist at a cross-over between specialist ICT and engineering skills (as a primary specialisation) and at least a basic understanding of agronomy, agriculture and/or food technology**. To complement the basic expertise of engineers and IT developers, several companies were also employing people with primary specialisation in agriculture.

Engineering and software development, as broad profiles, were the most mentioned broad areas of specialisation demanded by the companies. Further specialisation of desirable employees, involving a combination of IT development or engineering and knowledge of agriculture, depended on the specific products and technologies used by individual companies.

For instance, companies offering full-scale farm automation solutions have a demand for professionals in smart fertilising systems, smart irrigation, and smart farm management. Companies developing comprehensive solutions utilising enterprise-grade IoT, Machine Learning/Artificial Intelligence (ML/AI), and cloud technologies seek professionals who can perform software simulation, work with free and open-source software (FOSS), cybersecurity, cloud and mobile computing, Big Data, remote sensing technologies, embedded software and IoT. A company producing robotic systems also demands engineers in mechatronics and electronics, while drone producers – operators of drones, data analysts and specialists who master 3D mapping technologies.

The skillsets listed by the interviewed companies are covered by a number of standard occupations defined by ESCO, even though profiles combining specialist ICT skills with knowledge of agri-food are not reflected in the classification. The detailed mapping of occupational profiles and skills reflecting the skills demanded by the interviewed companies is presented in Annex 3. ESCO occupational profiles and skills. Meanwhile, the summary of occupations linked to these skills is provided in Box 1.

[31] Conversion rates for ALL to EUR are 116.12, see here; for BAM to EUR 0.51, see here; for MKD to EUR 61.7, see here and for RSD to EUR 117.32, see here. Kosovo and Montenegro use EUR. All rates for February 2023.

Box 1. Identified technical occupations based on companies' skill needs

Digital technologies		
Skills mentioned by companies		**Related ESCO occupations**
big data cybersecurity digital measuring instruments electronics embedded software and automation farm management information systems free and open-source software skills	mobile computing mechatronics sensing technologies smart fertilising systems smart irrigation smart agriculture smart technologies for plant disease and protection software development and simulation statistics	agricultural equipment design engineer (ESCO 2144.1.2.1) mechatronics engineer (2144.1.11) photonics engineer (2149.12.1) electronics engineer (2152.1) data analyst (2511.3) data scientist (2511.4) software developers (2512) embedded systems software developer (2514.2.1) industrial mobile devices software developer (2514.3) embedded systems security engineer (2529.3) remote sensing technician (3111.13) sensor engineering technician (3114.1.10) mechatronics engineering technician (3115.1.11) mechatronics assembler (8211.3) motor vehicle assembler (8211.5) electronic equipment assembler (8212.3)
Agronomy, agriculture and food processing		
Skills mentioned by companies		**Related ESCO occupations**
agriculture agro-economics agronomy smart agriculture	smart technologies for plant disease and protection food technology farm management information systems	agricultural scientist (ESCO 2132.1) agronomist (2132.2) food technologist (2145.1.4) agricultural technician (3142.1)

The list of demanded skills mentioned in the interviews relates to different ISCO levels. While the main focus is on professionals (ISCO group 2), the occupational levels of managers (ISCO 1), technicians (ISCO 3) and plant and machine operators (ISCO 8) also cover the demanded skills. Notably, as the companies are small and mainly focused on developing digital solutions, employees from the professional group dominate. As the companies grow and expand their production, assemblers are likely to be in higher demand. Accordingly, the required educational level can vary. For occupations from high-skilled ISCO occupational groups,[32] including professionals (group 2) and technicians and associate professionals (group 3), employees generally need to be educated at ISCED level 5 or higher. For the occupations of plant and machine operators and assemblers (ISCO group 8), the educational requirements are lower and generally range from ISCED level 2 to 4.[33]

In the EU, companies that develop digital solutions for agri-food demonstrate a demand for similar occupations in the group of professionals (ISCO 2), namely groups of science and engineering professionals (21) and ICT professionals (25). Specific occupations identified as relevant by EU companies include installation engineers (ESCO 2149.2.5), mechanical (2144.1) and mechatronics (2144.1.11) engineers, as well as computer hardware (2152.1.1) engineers. Moreover, companies search for application developers (ESCO 2514.2), software developers (2512) and ICT system configurators (2522.1). Data scientists and analysts (ESCO 2511.3 and 2511.4, respectively) are also in high demand. Finally, the EU companies actively look for agronomists (ESCO 2132.2). These broader profiles are cross-cutting in the sense that they are required for the development and production of a wide range of technologies applicable in agri-food.

[32] We define high-skilled occupations as ISCO occupational groups 1, 2, and 3. Lower-skilled occupations refer to ISCO occupational groups 4, 5, 6, 7, 8 and 9.
[33] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.

However, when it comes to the demand for knowledge of more specific technologies, both differences and some similarities emerge between the Western Balkans and the EU. The main difference relates to the scope and different levels of advancement of economic activities related to the development and production of digital solutions for agri-food. This niche has developed rapidly in the EU in the past decade, driven by the policy measures encouraging the digital and green transformation in the sector, as well as notable public and private investment.[34] In the Western Balkans, development of IoT, geo-spatial technology, mechatronics, and distributed ledger solutions for agri-food are present only in some of the economies and is small scale.

Nevertheless, the demand for technical skill profiles linked to IoT, drones and geo-spatial technology in agri-food, as well as an increasing need for skills in plant disease detection (which relates to remote sensing) was found both in the EU and the Western Balkans. In addition, the development and applications of robotics solutions, although still explored only to a small extent in the Western Balkan region,[35] is an emerging trend in the EU and globally. Skills at the intersection of agri-food and robotics, therefore, have the potential to increase in demand in the future with increasing technology diffusion.

It is also important to note that certain technologies that emerged as trending in the EU-level analysis and as present in the Western Balkans are mentioned in the smart specialisation documents of all Western Balkan economies, although not necessarily in the context of agri-food digitalisation (see the Table 4). For example, in Albania, the digitalisation of agriculture is not identified as a priority. This lack of focus on the area is also reflected in the absence of companies developing digital solutions for agri-food identified in this country. Nevertheless, the development of digital technologies including IoT, robotics and data analytics are listed as potential development opportunities in smart specialisation priority domains mapping. Similarly, relevant technologies are mentioned in Kosovo's, Montenegro's and North Macedonia's smart specialisation documents within the ICT priority area. Meanwhile, Serbia not only mentions most of the key identified technologies as part of the ICT priority area, but also cites these technologies as enablers in the agri-food related priority area. This indicates that even in the context of slow development of the digitalisation for agri-food market niche in these countries, the demand for related skills and occupations will remain and grow.

[34] GovGrant (2022). Are we investing enough in AgriTech to feed the world? What the numbers tell us. Available here.
[35] Robotics was only mentioned by stakeholders from Serbia and North Macedonia among the potentially demanded future skills.

Table 4. Key technologies, related occupations in Western Balkans and the EU, and country-specific priorities

Technology	ESCO-related occupations	Country-specific priorities
Internet of Things (IoT)	installation engineers (2149.2.5) embedded systems software developer (2514.2.1) industrial mobile devices software developer (2514.3) ICT system configurators (2522.1) embedded systems security engineer (2529.3)	**Albania**: the use of digital technologies, including IoT, is mentioned as a possible development opportunity across sectors, including agriculture[36] **Kosovo**: advanced ICT services, including IoT, are mentioned as a possible sub-area for smart specialisation within the ICT priority area[37] **Montenegro:** IoT is mentioned in Smart Specialisation Strategy of Montenegro within the ICT priority area[38] **North Macedonia:** advanced ICT services, including IoT, are mentioned as a possible sub-area for smart specialisation within the ICT priority area[39] **Serbia**: IoT is mentioned in Smart Specialisation Strategy of Serbia within the ICT priority area and Food for Future priority area[40]
Geo-spatial technologies (including remote sensing)	mechanical engineers (2144.1) mechatronics engineers (2144.1.11) installation engineers (2149.2.5) photonics engineer (2149.12.1) computer hardware engineers (2152.1.1) ICT system configurators (2522.1) remote sensing technician (3111.13) sensor engineering technician (3114.1.10)	**Albania**: the use of digital technologies, including sensors, is mentioned as a possible development opportunity across sectors [41] **Kosovo**: advanced ICT services, including sensors, are mentioned as a possible sub-area for smart specialisation within the ICT priority area[42] **Montenegro:** use of sensors for monitoring the environment and production, storing and transport of food is mentioned in the Smart Specialisation Strategy of Montenegro[43] **North Macedonia:** the use of sensors is mentioned as part of a proposed Smart Agriculture sub-area for smart specialisation[44] **Serbia**: sensors, satellites and geolocation are mentioned in Smart Specialisation Strategy of Serbia as a part of Food for Future priority area[45]

[36] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[37] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[38] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[39] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[40] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[41] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[42] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[43] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[44] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[45] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Technology	ESCO-related occupations	Country-specific priorities
Mechatronics (including robotics and drones)	mechanical engineers (2144.1), including mechatronics engineers (2144.1.11) and agricultural equipment design engineer (2144.1.2.1) installation engineers (2149.2.5) computer hardware engineers (2152.1.1) ICT system configurators (2522.1) mechatronics engineering technician (3115.1.11) ICT system configurators (2522.1) mechatronics assembler (8211.3) motor vehicle assembler (8211.5)	**Albania**: the use of digital technologies, including robotics, is mentioned as a possible development opportunity across sectors [46] **Kosovo**: mechatronics (including robotics and drones) is not mentioned in smart specialisation documents **Montenegro:** mechatronics (including robotics and drones) is not mentioned in smart specialisation documents **North Macedonia:** mechatronics (including robotics and drones) is not mentioned in smart specialisation documents **Serbia**: autonomous driving and aviation systems are mentioned in Smart Specialisation Strategy of Serbia as a part of Key Enabling Technologies and Emerging Technologies priority area. Drones, satellites, and robotics are mentioned as a part of Food for Future priority area[47]
Big data, AI, data analytics, software development	data scientists (2511.3) data analysts (2511.4) application developers (2514.2) software developers (2512) ICT system configurators (2522.1)	**Albania**: the use of digital technologies, including data analytics, is mentioned as a possible development opportunity across sectors [48] **Kosovo:** software development, and advanced digital technologies, including AI and machine learning, are mentioned as possible sub-areas for smart specialisation within the ICT priority area[49] **Montenegro:** Smart Specialisation Strategy of Montenegro mentions big data, AI and software development as part of ICT priority area[50] **North Macedonia**: software development and advanced ICT services, including big data and business analytics, are mentioned as possible sub-areas for smart specialisation within the ICT priority area[51] **Serbia:** Smart Specialisation Strategy of Serbia mentions big data, business analytics, and AI as part of ICT priority area. AI is mentioned as part of Food for Future priority area[52]

[46] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[47] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[48] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[49] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[50] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[51] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[52] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Technology	ESCO-related occupations	Country-specific priorities
Cloud computing	application developers (2514.2) software developers (2512) ICT system configurators (2522.1)	**Albania**: cloud computing is not mentioned in smart specialisation documents **Kosovo**: cloud computing is not mentioned in smart specialisation documents **Montenegro**: Smart Specialisation Strategy of Montenegro mentions cloud services as part of ICT priority area[53] **North Macedonia**: advanced ICT services, including cloud services, are mentioned as a possible sub-area for smart specialisation within the ICT priority area[54] **Serbia**: Smart Specialisation Strategy of Serbia mentions cloud services as part of ICT priority area[55]
Distributed ledger technologies (including blockchain)	ICT system configurators (2522.1)	**Albania**: blockchain is not mentioned in smart specialisation documents **Kosovo:** blockchain is mentioned as one of the promising technologies for Kosovo in the future within the Creative Industries priority area[56] **Montenegro:** blockchain is mentioned in in Smart Specialisation Strategy of Montenegro as part of ICT priority area[57] **North Macedonia:** blockchain is not mentioned in smart specialisation documents **Serbia**: blockchain is mentioned in Smart Specialisation Strategy of Serbia as a part of Key Enabling Technologies and Emerging Technologies priority area and ICT priority area[58]

Note: No smart specialisation publications that outline country priorities were available for Bosnia and Herzegovina

[53] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[54] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[55] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[56] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise. Publications Office of the European Union. Available here.
[57] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[58] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Business development-related occupations and skills

The interviewed Western Balkan companies highlighted a demand for a variety of skills necessary for business development. Difficulties or issues in securing the necessary skillsets were common in all four Western Balkan economies in which the activities of development and production of digital solutions for agri-food were identified (i.e. Kosovo, Montenegro, North Macedonia and Serbia).

Among such specific skills, the interviewed companies from the region emphasised marketing, sales and internationalisation (including identification of new markets and business opportunities), business and strategic planning, project and financial management, human resources management, supply chain planning, accounting, and legal expertise. Similar skill shortages have been identified in the EU.[59]

Western Balkan interviewees also emphasised the importance of cross-cutting skills, e.g., digital literacy, skills in networking and building relations, and willingness to continuously learn and improve professionally. In addition to that, language skills were noted as increasingly important as companies expand into foreign markets, and companies found it challenging to find qualified workers proficient in English.

Based on the demand for skills emerging from the interviews, relevant business support occupations were identified by mapping the listed skills within the ESCO classification (see Box 3). Detailed information on skills and knowledge required for these occupations is presented in Annex 3. ESCO occupational profiles and skills, while Box 2 presents a summary of the most relevant occupations.

Box 2. Business support occupations relevant for digitalisation in agri-food based on companies' skill needs

Internationalisation	
• import export manager in agricultural machinery and equipment (ESCO 1324.3.2.1)	• import export specialist in agricultural machinery and equipment (3331.2.1.1)
• import export manager in computers, peripheral equipment and software (1324.3.2.8)	• import export specialist in computers, peripheral equipment and software (3331.2.1.8)
• import export manager in electronic and telecommunications equipment (1324.3.2.11)	• import export specialist in electronic and telecommunications equipment (3331.2.1.11)
Marketing and sales	
• digital marketing manager (1221.5)	• technical sales representative in electronic and telecommunications equipment (2434.4)
• advertising specialist (2431.3)	• wholesale merchant in agricultural machinery and equipment (3324.4.1)
• marketing consultant (2431.10)	• wholesale merchant in computers, computer peripheral equipment and software (3324.4.8)
• market research analyst (2431.11)	
• technical sales representative in agricultural machinery and equipment (2433.6.1)	
Business and project management	
• business manager (1213.5)	• project manager (1219.6)
Supply chain management and logistics	
• supply chain manager (1324.8)	• computers, computer peripheral equipment and software distribution manager (1324.3.1.6.8)
• agricultural machinery and equipment distribution manager (1324.3.1.6.1)	• logistics analyst (2421.5)
Accounting	
• accountant (2411.1)	• accounting assistant (3313.1)
Human resources management	
• human resources manager (ESCO 1212.2)	• human resources assistant (4416.1)
Legal	
• legal consultant (2619.7)	

[59] As emphasised by a representative of a non-profit organisation that supports youth initiatives and entrepreneurship in agriculture. The representative was interviewed as part of the EU Trends Report.

Most of these occupations belong to high-skilled ISCO groups of managers (ISCO group 1), professionals (group 2) and technicians and associate professionals (group 3) and therefore typically require education at ISCED 5 level or higher.[60]

In the EU, among similar companies, occupations that support commercialisation, marketing, digital marketing, and sales are also in high demand. These include marketing managers (ESCO 1221.3.2), digital marketing managers (1221.5), sales managers (1221.3.2.1), business development professionals (2431.5), and product and service managers (2431.15).[61] For such positions, employers demand an understanding of (precision) agriculture and demonstrable communications, marketing, sales and digital skills.

The demand for business support occupations grows as a company grows. Interviewed companies stressed the importance of skills in business support and internationalisation. Sought-after occupational profiles will increasingly combine skills in developing digital technologies with business skills for understanding how those technologies can be commercialised and marketed.

Skill supply

The growth of the activities of developing and producing digital solutions for agri-food, together with the emergence of small companies capable of driving smart specialisation in the region, have accentuated the limited supply of skills. Education and training provision must address the increasing demand for skilled workers with quality education in line with technological developments. Skill provision takes place through tertiary education and in-company training. Skills provided through VET, meanwhile, are mostly relevant for the *adoption* of technologies within agricultural holdings, rather than their *development.*

Initial vocational education and training

While the interviewed companies mostly look for employees with university-level education, VET can provide skills for boosting technology adoption in agri-food – which in turn is an important driver of the demand for digital solutions for agri-food. Programmes in agriculture, food production, as well as in ICT exist in all the Western Balkan economies (see Annex 4. Education and training programmes at VET and university levels). Unfortunately, the available data on ICT programme enrolment in VET in Western Balkans are very limited.[62]

However, the interviewed stakeholders emphasised the slow adaptation of training programmes to labour market needs, and the lack of links between the agri-food and ICT curricula. No formal training programmes have been identified in the Western Balkan region that combine specialist digital skills with education in agriculture or food processing. In agriculture programmes, ICT subjects only concern user-level skills. Meanwhile, technology programmes do not have focus/subjects on agri-food. Furthermore, interviewed companies felt that VET provision in the region is characterised by a lack of practical learning, and emphasis on theory rather than practical knowledge.

This issue of lack of practical knowledge in the study programmes has been recognised by some Western Balkan governments that have started reforming their VET systems. For instance, Serbia and North Macedonia have already adopted the dual secondary school system encompassing work-based learning, meaning that vocational schools collaborate with companies through programmes such as 'learn through work' in equipping young students with practical skills. During the 2021/2022 academic year there were already over 800 companies involved in this system in Serbia, suggesting a strong response from the business community. For the school year 2022/2023, out of 1 070 positions

[60] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.
[61] Based on the job postings analysis done for the EU trends report.
[62] Eurostat (2023). Pupils enrolled in vocational upper secondary and post-secondary non-tertiary education by education level, sex and field of education. Available here. Data on Montenegro is available for 2016 (826 students) and 2017 (820 students). For Bosnia and Herzegovina, available data indicates 25 students in 2016, 246 in 2019 and 869 in 2021. Other Western Balkan economies are not covered.

opened for 'Agricultural technician' in Serbia, 32 were in dual education.[63] At the same time, the opportunities created by the dual VET in the region are not easily applicable in agricultural holdings that apply digital solutions. According to interviewees, to succeed, VET providers need additional teacher training in digital technologies in agri-food; and equipment for laboratories on which new technologies can be taught.

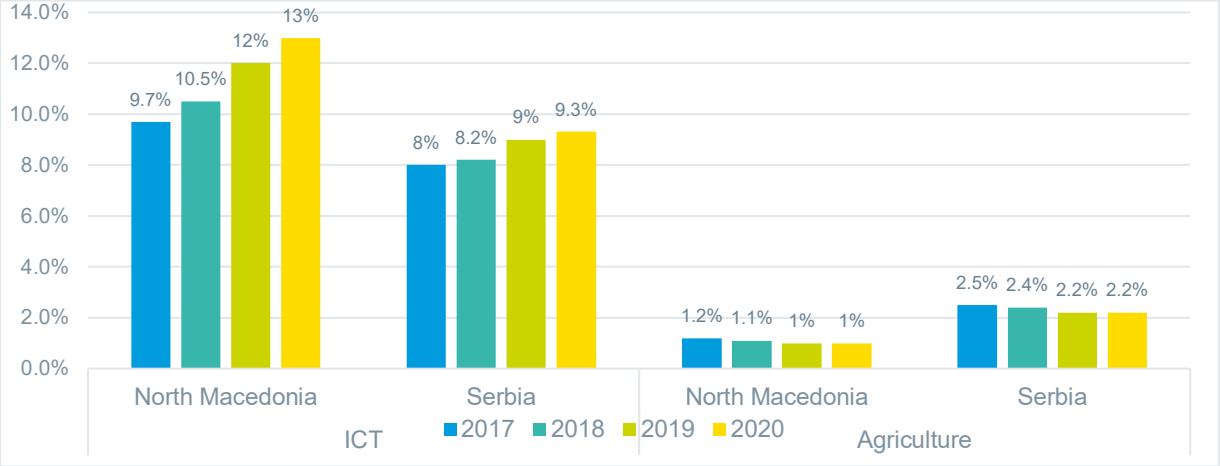
Serbian stakeholders stressed that collaboration between VET schools and companies developing digital solutions for agri-food is virtually non-existent. The reason for that is partly related to the fact that the VET schools are not offering occupational profiles that the companies seek, which is likely the case in other countries of the region as well. Among the Western Balkan economies, limited cooperation between companies belonging to the digitalisation niche and VET institutions were identified through interviews only in Albania and North Macedonia and even here they were mostly ad hoc. Such cooperation generally consists of companies cooperating with VET institutions, outside the formal curricula, on e.g. the use of drones, software for high precision aerial 3D maps, or robots for applying pesticides.

Higher education

University education is a precondition for most positions in companies that are active in digitalisation in the agri-food market niche. All the Western Balkan economies have universities that offer relevant study programmes (e.g. programming, electronic engineering, mechanical engineering, as well as agriculture, food technology and agronomy). The list of relevant programmes is provided in Annex 4.

Available data demonstrate that the share of students in tertiary programmes in agriculture has been slightly decreasing in North Macedonia and Serbia during 2017-2020 (see Figure 13; comparable data on other Western Balkan countries were not available). At the same time, the share of students in ICT has increased steadily in both countries in the same period. The difference between enrolment in ICT and agriculture programmes suggests that the popularity of agriculture is decreasing.

Figure 13. The share of students enrolled in tertiary programmes in Information and Communication Technology and Agriculture



Source: shares calculated based on Eurostat [EDUC_UOE_ENRT03]

Interviewed stakeholders from all countries in which the niche activities are present – Serbia, North Macedonia, Montenegro and Kosovo – emphasised a lack of multi-sectoral, interdisciplinary programmes at tertiary level. Agri-food-related subjects have not been identified in programmes focused on specialist ICT skills. Meanwhile, students at agricultural faculties have courses on ICT, those concern the usage rather than the development of technological solutions (i.e. users, not specialist skills; see the box below for examples).

[63] Република Србија. Министарство просвете, науке и технолошког развоја. Прелиминарни план уписа ученика у средњу школу за школску 2022/2023.

Box 3. Examples ICT-related subjects in agri-food programmes in Western Balkans

Albania: The Agricultural University of Tirana (AUT) has set up an experimental didactic centre (DEF) to help equip students with cutting-edge skills in agri-food. The Didactic Experimental Farm (DEF) is one of the largest farms in the country with an area of 117.5 ha. As part of its DEF, and in cooperation with the Ministry of Agriculture and Rural Development (MARD), the AUT is developing a national pilot farm for student training in precision agriculture.

Kosovo: Educational programmes at the University of Pristina, Faculty of Agriculture and Veterinary, include courses on automation and technology such as:

- Fundamentals of Technology;
- Processing techniques, measurements and automation;
- Technology of fruit and vegetable, alcoholic and non-alcoholic beverages, milk and milk products;
- Information science and communication.

These courses do not provide specialised ICT skills for agriculture. They serve mainly general purposes and equip students with very general skills.

Montenegro: IT courses exist in almost each study programme in agriculture-related subjects (the list of programmes is provided in Annex 4). For example, an undergraduate study programme Plant Production contains a course 'Mathematics with IT', where the focus is on basic programmes, such as Excel, Word, and R.

Finally, the interviewed businesses emphasised that, generally, recent university graduates lack practical skills. They deemed the education programmes to be too general, theoretical and lacking focus on transferable and cross-sectoral skills. In addition, stakeholders from all Western Balkan economies emphasised that higher education curricula are not sufficiently linked to the labour market needs. The technical skills gained at universities are increasingly obsolete given the developments in research, innovation and labour markets.

On-the-job learning in companies

Given the shortcomings of VET provision and higher education, companies (primarily start-ups) providing digital solutions for agribusinesses often must address their skill needs on their own through on-the-job training. Hence, adult learning remains an important part of the skill supply for the niche in the Western Balkans.

In-company training and learning on-the-job, according to company interviews, remain the key means of addressing shortcomings in both VET and higher education: i.e. merging specialist ICT skills with knowledge in agriculture. For example, in Serbia and Albania,[64] new employees require a year-long training period from their employers. Employers also offer continuous training and upskilling opportunities for permanent employees. Mentorship by senior colleagues is among the main methods of developing the skills needed from the new hires to contribute to company activities. Other forms of on-the-job training offered by the interviewed companies from different Western Balkan economies range from workshops, conferences, trainings, and seminars to individual (online) learning with courses offered by various vendors (this is especially relevant for specific programming skills/languages).

Non-formal and informal training offer

Provision of non-formal and informal training on the development and production of digital solutions for agri-food is limited in Western Balkans. Out of the technologies identified in the study as being essential for the development of the niche, most of the available training offer focuses on general purpose digital skills in data analytics and software development. Although most of this training is not focused specifically on solutions for agri-food, it is useful for the sector. In addition to this, the study identified a number of business intermediary bodies that have provided training on the application of these technologies in agri-food (including training for SMEs from various sectors, including

[64] While no companies that produce digital solutions for agri-food were identified in Albania, there are companies that apply digital technologies (e.g. companies that offer digital information platforms for agri-food producers).

agribusinesses). Besides application of data and software solutions (e.g. e-commerce), this training also involves the use of drones (i.e. drone pilot training) and IoT devices for agri-food (see Table 6 below).

For example, in Bosnia and Herzegovina, the Intera Technology Park runs a project called 'Agripreneur' aimed at equipping young entrepreneurs in agriculture with business development skills and knowledge in new technologies. Although the project is not specifically geared for developers of technologies in agri-food, its focus on skills development in networking, project management, and innovation in agri-food is important for raising awareness and interest in digital innovation for agri-food holdings. Furthermore, the BioSense Institute in Serbia offers tailored opportunities for continuous training in agri-tech. In 2018, they launched the first digital farm in Serbia, a platform that aims to network farmers and provide knowledge on implementing precision agriculture solutions, which was followed by a Digital Village project in 2022.[65]

Table 5. Non-formal and informal training on key technologies

Technology	Identified non-formal / informal training offer	
	Development	**Application in agri-food**
Internet of Things (IoT)	N/A	• **BiH**: Smart Village Knezica • **Serbia**: Digital Farm and Digital Village projects by BioSense Institute
Geo-spatial technologies (including remote sensing)	N/A	• **Serbia**: Digital Farm and Digital Village projects by BioSense Institute
Mechatronics (including drones and robotics)	N/A	• **Serbia**: training of drone pilots by Drone Pilot Serbia Association • **Serbia**: Digital Farm and Digital Village projects by BioSense Institute
Data and software (incl. big data, AI, data analytics, software development, cloud computing, blockchain)	• **Albania**: Trainings by Risi Albania, collaborations of Chamber of Commerce and Industry of Tirana • **BiH:** Trainings by Innovation centre Banja Luka, INTERA Technology Park • **Kosovo:** Trainings by Innovation Centre Kosovo, Kosovo ICT Association (STIKK) • **North Macedonia:** The Chamber of Commerce for ICT (MASIT)	• **Albania:** e-commerce trainings by SME Academy, Risi Albania, ABA Online; trainings by Centres of Agricultural Technology Transfer • **BiH:** trainings by Smart Village Knezica, INTERA Technology Park (project Agripreneur), Foreign Trade Chamber of BiH, and FBiH and RS Chambers of Commerce • **Kosovo:** Jakova Innovation Center • **Montenegro:** Innovation Fund, Tehnopolis • **North Macedonia:** Macedonian E-Commerce Association • **Serbia:** Digital Farm and Digital Village projects by BioSense Institute

Instances of international partnerships to train young workers from Western Balkans in digital skills from agri-food were identified as well, as presented in the box below.

[65] Available here.

Box 4. International training course on digital skills

A new CVET initiative starting in 2023 is a training course 'Digital skills enhancement in Green & Blue Economy', which is part of the Food4Heatlth project, funded by the INTERREG IPA CBC ITALY–ALBANIAMONTENEGRO PROGRAMME and executed by CIHEAM Bari. It involves Italy, Albania and Montenegro. The goal of the project is to accelerate the process of innovation and competitiveness of companies and start-ups with technological solutions applied in the different areas of the chain: production and processing, management and monitoring, packaging/labelling, transport and logistics, by-product enhancement, sales.

The course organisers selected 30 participants for a 4-month training. The training aims to provide a combination of mindset training and real work experience in private companies for recent graduates from the Western Balkans, in order to develop real solutions for business challenges in multidisciplinary working groups.

The first training held in the Mediterranean Agronomic Institute of Bari in Italy focused on business model design and social innovation, agile methods, change management and digital innovation. It was followed by a three-month project work in companies.[66]

Overall, however, most of the skill provision to SMEs (that either focus specifically on agri-food companies or a wider range of sectors, including agri-food) concern training in areas related to business development. Such training by various business intermediary bodies was identified in all six Western Balkan economies. To illustrate, the BioSense Institute in Serbia offset the BioSense Accelerator – an intensive 3-month programme that targets early-stage agri-tech start-ups and offers training on developing business ideas, defining business models, and conducting detailed analysis of the market and competition.[67] In addition, ad hoc training on digital marketing has been organised by EIT Food Hub Serbia.[68] Similar continuous or ad hoc business development-oriented training and mentorship are offered to companies, including agri-food businesses, by FIDT in North Macedonia, Innovation Centre Banja Luka in Bosnia and Herzegovina, ABA Online in Albania, Tehnopolis in Montenegro, and STIKK in Kosovo.

Challenges in skill matching

The current skill supply by the education and training institutions in the Western Balkan region does not prepare sufficient numbers of specialists with skills that immediately transfer to companies engaged in the development and production of digital solutions for the agri-food sector. This concerns both the skills that are currently needed by the SMEs in the study and the skills that are likely to be demanded in the area as the niche develops. The problem is most visible in the Western Balkan economies in which the development of the niche is gathering pace, namely Serbia and North Macedonia, and (to a smaller extent) Kosovo and Montenegro (see the table below).

Table 6. Challenges in skill matching in the digitalisation for agri-food niche

	Level of niche development	Main challenges in skill matching
Development and production of digital solutions for agri-food		
AL	No developer / producer companies identified. Main focus on businesses applying digital solutions.	Low levels of user digital skills among people working in agricultural holdings; lack of education on the benefits or agriculture digitalisation.
BA	No producer companies identified. Focus on businesses applying digital solutions. Single case identified of experimentation in developing digital innovations for agri-food.	The niche development is restricted by the absence of university-educated specialists combining user and specialist digital skills with knowledge of agriculture, as well as lack of training in skills in commercialisation and business development. On the application side – low levels of user digital skills among people working in agricultural

[66] More information is available here.
[67] More details available here.
[68] More information is available here.

	Level of niche development	Main challenges in skill matching
		holdings; lack of education on the benefits of agriculture digitalisation.
XK	Producer and developer companies are slowly emerging, although activities remain low-scale. The domestic demand for their digitalisation solutions remains low.	Notable shortage of ICT specialists in Kosovo's labour market. No specific education or training programmes combining specialist ICT skills with knowledge of agriculture.
ME	Producer and developer companies are emerging, although activities remain low scale. The domestic demand for their digitalisation solutions remains low.	Absence of interdisciplinary education or training programmes combining specialist ICT skills with knowledge of agriculture. Meanwhile, education in agri-food related occupations in VET and universities suffer from outdated teaching techniques and limited provision of practical skills
MK	Producer and developer companies are emerging, although activities remain low scale. Some export activities take place. The domestic demand for digitalisation solutions and agri-food digitalisation remains low.	Notable shortage of ICT specialists willing to work for local companies. No specific education or training programmes combining specialist ICT skills with knowledge of agriculture. Lack of user digital skills within the agri-food sector.
RS	The activities of development and production of digital solutions for agri-food are the most developed and active in the region.	Obsolete study curricula, limited opportunities to gain practical skills and insufficient integration of university research and innovation. Stronger emphasis on the demand for transversal skills is needed. Weak relevance of VET studies for the labour market demand.

The main gaps in technical skills concern specialist-level qualifications in ICT combined with a knowledge of agriculture. With the development of the sector, these skills shortages are likely to worsen in the future, when the skill demand will rise along with the need for technology skills. Given the developments in the EU, these are likely to include combining a knowledge of agriculture with robotics, IoT, and geospatial technologies, among others. Although there are university education programmes that cover subjects related to some of these technologies (e.g. Mechatronics or Mechanical engineering), the link to agri-food is missing. Furthermore, just as in the EU, the university programmes do not put enough emphasis on practical skills, and often fail to keep their study curricula up to date with the latest technological developments.

This results in the need for continuous and on-the-job training of new recruits to be able to start contributing to the companies' work. Various forms of on-the-job learning and non-formal and informal training remain the most important channels for developing the niche-specific skills, combining practical specialist technology competences with knowledge of agri-food production.

Stakeholder collaboration – including SMEs, education institutions and business intermediary bodies – is important to ensure that the need for company skills is addressed. As showed in the analysis of skill supply, individual initiatives exist in Western Balkan economies, in which business intermediary bodies play a role in adult training and help SMEs to secure knowledge on topics related to business development and user skills to deploy digital innovations on farms. Nevertheless, these efforts do not extend to the provision of important technical skills in technology development for agri-food.

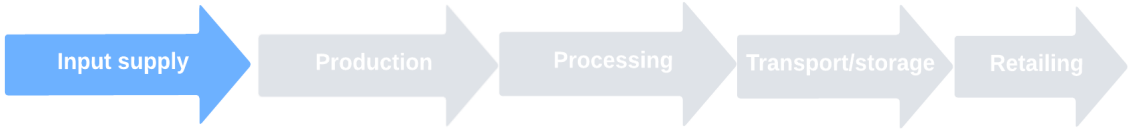
At the same time, skills needed for the application of digital technologies in agricultural holdings are also lacking, which negatively affects the demand for such products. VET and initiatives in informal and non-formal training show the potential for developing user skills needed to boost the adoption of digital solutions in agricultural production. However, VET programmes also require revision and continuous updates to serve this purpose properly. Obsolete skills and a lack of links to the labour markets needs have been identified as a major issue in VET, just as in the university level education.

Biochemical and microbial products for agri-food

Overview

The niche of biochemical and microbial products analysed in the study concerns the development and production of biochemical and microbial products for agri-food, primarily innovative Plant Protection Products (PPPs) and bio-fertilisers. The companies engaged in these activities operate on the input level of the agri-food value chain, as shown in Figure 14. Biochemical and microbial products contribute to protecting crops and are considered a safer substitute for chemical PPPs that are widely applied in plant protection.

Figure 14. Biochemical and Microbial Products niche within the agri-food value chain



Biochemical and microbial products help maximise productivity and the quality of products of the agri-food value chain. Although some of the PPPs and fertilisers of natural and microbial origin have been used in agriculture for millennia (e.g. biochar that affects soil microbial community structure, and alter the abundance of soil bacteria and fungi[69]), new technologies developed in the fields of biotechnology and microbiology, such as precision fermentation, 3D printing of bacteria, protein modelling, pattern recognition methods, the use of AI and IoT in food production, are all driving the development of this niche.

The niche of biochemical and microbial products for agri-food falls under the following NACE sectors, to the extent that the companies in these sectors specialise in the production of biochemical and microbial products:

- Manufacture of fertilisers and nitrogen compounds (C20.1.5).
- Manufacture of pesticides and other agrochemical products (C20.2).
- Support activities for crop production (A1.6.1).
- Post-harvest crop activities (A1.6.3).
- Research and experimental development on biotechnology (M72.1.1).

The production of biochemical and microbial products is growing fast in Europe. One representative of an EU biocontrol agency even suggested to no longer refer to it as 'niche' economic activities anymore. This dynamism was captured by market research agencies, such as Mordor Intelligence, which estimated that the European agricultural microbials market will witness a compound annual growth rate (CAGR) of 15% from 2016 to 2026.[70]

One of the reasons for the accelerated growth of production is that biochemical and microbial products facilitate sustainable production practices, thereby conforming with green economy policy initiatives. Biochemical and microbial PPPs and fertilisers differ from conventional PPPs and fertilisers in that they are based on natural products. They help offset the environmental damage caused by chemical pesticides, thus facilitating the progress towards the green economy policy priorities.

[69] Zhao, Y., Wang, X., Yao, G., Lin, Z., Xu, L., Jiang, Y., & Ping, L. (2022). Advances in the effects of biochar on microbial ecological function in soil and crop quality. Sustainability, 14(16), 10411.
[70] Mordor Intelligence (2022). Europe Agricultural Microbials Market -Growth, Trends, COVID-19 Impact, And Forecasts (2022 - 2027). Available here.

The EU has recognised this potential through its policy initiatives, such as the European Green Deal,[71] the Farm to Fork (F2F) Strategy,[72] the EU Chemicals Strategy for Sustainability, as well as new EU-level Regulations, such as the Fertilising Products Regulation (FPR). These initiatives and strategies directly refer to biochemical and microbial products as an avenue for making agriculture more sustainable.

Meanwhile, most Western Balkan governments do not mention biochemical and microbial products for agri-food, nor their potential in their strategic documents.[73] Serbia and North Macedonia are exceptions. In Serbia, the government has identified innovative food production practices among the important future developments for smart specialisation. This includes the development of biotechnologies, production of mineral and microbiological fertilisers, and of biological agents for pest and disease control.[74] In North Macedonia, the mapping of potential priority areas for smart specialisation mentions the production of mineral and microbiological fertilisers and biological and chemical agents for combating pests and diseases as a part of a proposed Smart Agriculture priority sub-area.[75]

In Serbia, a well-connected system of publicly funded research institutes, universities, and business stakeholders exists. The producers of biochemical and microbial products benefit from this interconnection between public authorities and research institutions. To illustrate, there is government support for research activities in the biochemical and microbials' niche, especially in the context of the BIO4 initiative that identifies biotechnology and life sciences as top priorities for the Serbian Government (see the box below).[76] Apart from the BIO4 campus, Serbia boasts four science-technology parks in Belgrade, Novi Sad, Niš and Čačak, and a national data centre supported by an Nvidia supercomputer. However, no similar initiatives were identified in other Western Balkan economies.

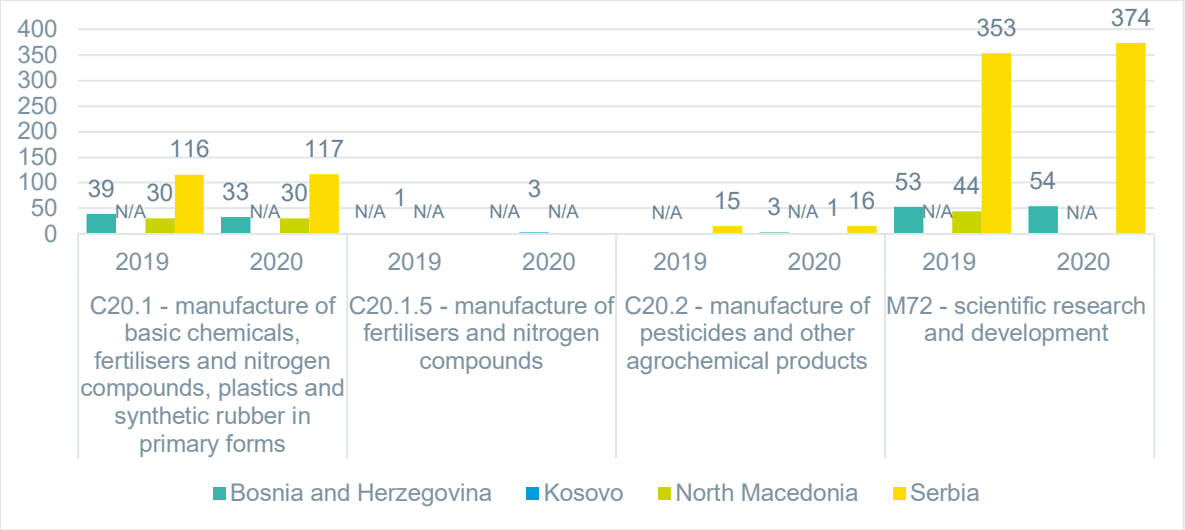
Box 5. BIO4 complex

Serbia's BIO4 is a multidisciplinary R&D complex for life sciences, which will focus on biotechnology, biomedicine, bioinformatics and biodiversity. The goal of the BIO4 campus is to support innovation in the four fields by networking higher education stakeholders, academics and researchers, start-ups, and the public - by hosting a convention and multimedia museum centre.[77]

The data collected for the study showed that compared to the EU, the activities of developing and manufacturing of biochemical and microbial products in the Western Balkans are considerably less developed. Statistics that could help to understand the size of the niche are scarce, as it entails very specific activities covered under several different NACE codes, without indication which of them specialises in microbial and biochemical products specifically (see the Figure 15). While no comparable statistics was available for Albania and Montenegro, the collected qualitative insights show that no companies exist that engage in these activities. Same situation was identified in Bosnia and Herzegovina. In Albania and Montenegro, the research only identified companies that import, distribute and sell biochemical and microbial products (rather than develop and produce them). Serbia, meanwhile, has the largest number of companies engaged in the manufacture of fertilisers, pesticides and other agrochemical products.

[71] European Commission. (2022). A European Green Deal. Available here.
[72] European Commission (2020). Farm to Fork Strategy. Available here.
[73] Including Smart Specialisation Strategies and Economic Reform Programmes.
[74] Government of the Republic of Serbia (2020). Smart Specialisation Strategy of the Republic of Serbia 2020-2027. Available here. p. 71.
[75] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[76] See BIO4.rs (2022). Available here.
[77] See BIO4.rs (2022). Available here.

Figure 15. Number of companies from NACE sectors related to the development and manufacturing of biochemical and microbial products



Source: Eurostat (2023) [SBS_SC_SCA_R2]. Data for Kosovo: Ministry of Industry, Entrepreneurship and Trade of Kosovo (2020). Manufacturing Industry – Sector C Report. Available here, p. 88.

Several biochemical and microbials producers – i.e. companies belonging specifically to the investigated niche – were identified in Kosovo, North Macedonia, and Serbia (see Annex 2. Company profiles). Out of the three Western Balkan economies with activities in this market niche, Serbia stands out in terms of production and exports of microbial and biochemical products for agriculture and food processing. Biotechnology research and development in Serbia is well-developed in comparison to other Western Balkan economies and even some EU Member States. In North Macedonia, fewer biochemical and microbial companies are active, especially in the area of research and development. In Kosovo, only a couple of micro companies with intermittent activities were identified.

The primary markets for these producers are mostly domestic. Only two of the interviewed companies, one from Serbia and another from North Macedonia, export their production to other Western Balkan countries, as well as to the EU and global markets. Nevertheless, these companies consider the EU's single market a 'complicated' export market due to strict regulations for chemical products, and specifically chemicals for agriculture. As a result, they focus on the neighbouring Western Balkan markets and the US instead.

Larger biochemical and microbial companies also operate in the region (e.g. Agrounik[78] and Fitofert[79] in Serbia), but the majority of enterprises representing the niche are small start-ups. The enterprises involved in the study engage in research, innovation and product development, as well as manufacturing activities. For instance, an interviewed Serbian company engages primarily in R&D and developing innovative solutions for food packaging, such as bio-polymer emulsion that prevents the rotting and spoilage of fresh foods. Another interviewed company from Serbia develops innovative solutions for microbial fertiliser made for soy cultivation. The Kosovan companies from the interview sample are involved with food-waste processing to develop biogas and fertilisers, as well as innovative protein production from insect cultivation. The North Macedonian businesses develop enzymes for winemaking and mixtures and components for animal feed. Although the operations remain particularly small scale, these indicate the potential of innovation in biochemicals by Western Balkan start-ups.

[78] https://agrounik.com/about-us/
[79] https://fitofert.com/

Skill supply and demand

Employment profile

Looking into the broader NACE sectors under which the companies developing and manufacturing of biochemical and microbial products for agri-food operate, the available comparable statistical data is incomplete. What the data does show, however, is that in Montenegro, North Macedonia and Serbia, the relevant sectors contribute to particularly small shares of the total employment (see Table 7). The results of analysis in Albania and Bosnia and Herzegovina suggest that the production of chemicals for agri-food activities do not take place in these countries, while no comparable statistics exist for Kosovo. Meanwhile, the data on employment in these sectors by education are not available in the target countries.

Table 7. The share of employees in sectors relevant for the Biochemical and microbial products niche, Registered employment, 2021

NACE sector	*Montenegro*	*North Macedonia*	*Serbia*
Total employment	188,964	602,722	2,212,631
A - Agriculture, forestry and fishing	**0.96%**	**2.13%**	**1.34%**
A1 - Crop and animal production, hunting and related service activities	0.71%	1.62%	1%
C - Manufacturing	**6.21%**	**21%**	**22.3%**
C20 - Manufacture of chemicals and chemical products	0.085%	0.21%	0.627%
M - Professional, scientific and technical activities	5.57%	4.12%	5.22%
M72 - Scientific research and development	0.07%	0.12%	0.51%

Source: Statistical yearbooks of Montenegro, North Macedonia and Serbia

The Western Balkan biochemical and microbial companies interviewed for the study were mostly micro companies with fewer than 10 staff. The companies in Serbia, North Macedonia and Kosovo mostly employed people with university level education (at ISCED level 6 or above), mostly professionals (engineers) or technicians in agriculture, food technology, biotechnology, chemistry, microbiology, ICT, sales, and marketing. A small-sized company in Serbia also employed production operators with vocational education.

Looking at the general salary statistics by the relevant broader NACE sectors, although some of them are generally low-paying, the exceptions that exist concern the most innovative companies. In particular, companies engaged in Scientific research and development (M72) stand out with high salaries across the region (see Table 8), which potentially indicates the attractiveness of the sector for workers. However, companies in Serbia reported difficulties in providing competitive salaries to workers.

Table 8. Average monthly income (net) in the Western Balkan region, disaggregated by economic activities (% of total average salary, EUR)

Monthly salary	*Albania*	*Bosnia and Herzegovina*	*Kosovo*	*Montenegro*	*North Macedonia*	*Serbia*
Total average salary (EUR)	462	511	432	532	465	561
A - Agriculture, forestry and fishing	65%	87%	62%	85%	80%	85%
A01 - Crop and animal production, hunting and related service activities	n/a	65%	n/a	86%	80%	86%
C - Manufacturing	86%	77%	78%	74%	85%	87%
C20 - Manufacture of chemicals and chemical products	n/a	102%	n/a	68%	125%	109%
M - Professional, scientific and technical activities	109%	109%	106%	n/a	120%	129%

M72 - Scientific research and development	n/a	181%	n/a	n/a	127%	207%

Note: All salaries are net. There were no data on net salaries for Albania, so we recalculated the gross by using the tool available on the website for the Albanian General Directorate for Taxes, available here. Data on most salaries was available only in national currencies. Salaries were converted to EUR using the exchange rates for February 2023.[80] After conversion of the national currencies to EUR, we calculated the percentages for economic activities related to the total average salary in the country.

Skill demand

Technical occupations and skills

In the interviews, the SMEs that are active in biochemical and microbial production identified both specific occupations and general skills of interest to them. Overall, they primarily focused on technical skills required for company operations, including agriculture, microbiology, biotechnology, food technology, as well as ICT skills. A **knowledge of Life sciences** in the fields of biology, biotechnology, chemistry, as well as environmental protection and agriculture were listed as crucial. Specific skills and knowledge areas include cultivating plants, trees, and vineyards, good agricultural practices, nature-based production practices, and the ability to deploy non-harmful methods in the field. Additionally, the interviewees mentioned the need for knowledge and skills in food technology and veterinary medicine.

When it comes to niche specificities, competences related to **plant protection** were at the core of the skills needs of biochemical and microbial companies in the Western Balkan region. This entails a knowledge of detecting plant diseases and a knowledge of the legal codes pertaining to the use of PPPs.

Furthermore, advanced user ICT skills have become a general requirement for most occupations due to the increasing digitalisation of economic activities. The **cross-over between user technology skills, biotechnology and food technology** was emphasised as being especially important for the start-ups operating in the niche in the interviews. Specific digital and technological skills reported by the interviewees were smart agriculture and an ability to apply modern technologies for the purpose of plant protection and environmental protection.

The specific occupations and skills in demand mentioned by the interviewed companies, and described above, are covered by or coincide with several standard occupations defined by ESCO.[81] While the detailed mapping of skills and occupations is presented in Annex 3, the summary is provided in the box below.

Box 6. Technical occupations relevant for biochemical and microbial products niche based on companies' skills needs

Biology, biotechnology, chemical technology and genetics	
Skills mentioned by companies	**Related ESCO occupations**
Biotechnology Chemical technology Detection of plant diseases Genetic engineering Microbiology Physico-chemical and microbiological analysis	bioinformatics scientists (2131.3) **biochemist (2131.4.2)** biomedical scientists advanced (2131.4.3) biophysicists (2131.4.4) geneticists (2131.4.8) **microbiologist (2131.4.10)** biology technicians (3141.2.3) bacteriology technicians (3141.2.1) biochemistry technicians (3141.2.2)

[80] Conversion rates for ALL to EUR are 116.12, see here; for BAM to EUR 0.51, see here; for MKD to EUR 61.7, see here and for RSD to EUR 117.32, see here. Kosovo and Montenegro use EUR. All rates for February 2023.

[81] Using the ESCO classification of Skills, Competences and Occupations. More information on skills required for these occupations is available in Annex 3.

Environmental sciences	
Skills mentioned by companies	**Related ESCO occupations**
Nature-based production practices Environmental protection	ecologists (2133.5) environmental experts (2143.2)
Agriculture, agronomy and veterinary science	
Skills mentioned by companies	**Related ESCO occupations**
Agriculture Agro-economics Animal nutrition Agronomy Precision farming Plant protection Patterning raw materials in food processing Plant, trees and vineyard cultivation Veterinary medicine	**agricultural scientist (2132.1)** **agronomist (2132.2)** **soil scientist (2133.11)** **agricultural engineer (2144.1.2)** **agricultural technician (3142.1)** horticulture production manager (6113.2) veterinarians (2250) veterinary technicians and assistants (3240)
Food technology	
Document organoleptic analyses Food technology	**food technologist (2145.1.4)** **food biotechnologist (2131.5)** food analysts (3111.3)
Machinery operators and elementary occupations	
No specific skills requirements	**machinery operators (ISCO group 8)** **elementary occupations (ISCO group 9)**

Note: occupations in bold were mentioned by the interviewees directly. Others were specified by linking the skills mentioned in interviews to ESCO occupations.

Education levels typically required for these occupations vary. For high-skilled occupational groups,[82] employees generally need to be educated at ISCED level 5 or higher[83]. For low-skilled occupations from plant and machine operators and assemblers group (ISCO 8), the educational requirements are lower and range from ISCED level 2 to 4. For elementary occupations (ISCO 9), at least primary education (ISCED level 1) is needed. [84]

In the EU, the situation for occupational areas in demand looks similar. Those especially sought-after are chemists (ESCO 2113.1) and biochemists (2131.4.2), biophysicists (2131.4.4), geneticists (2131.4.8), microbiologists (2131.4.10), agricultural scientists (2132.1), agronomists (2132.2), environmental programme coordinators (2133.6), soil scientists (2133.11), environmental engineers (2143.1), and biochemical engineers (2145.1.1). Among technicians, chemistry technicians (3111.1), chemical engineering technicians (3116.1), chemical processing plant controllers (3133.1), biochemistry technicians (3142.2.2), biology technicians (3142.2.3), and agricultural technicians (3142.1). Many of these occupations are in demand in both regions, despite the differences in the scope of development and production activities.

However, the insights from the interviews with stakeholders representing the niche in the EU revealed likely trends in the skills demand for the development and manufacturing of biochemical and microbial products for agri-food. Driven by the growing scale of these activities and increasing sophistication of practices and methods applied in research and product development, the profiles of workers are likely to require increasingly specific and sophisticated skills. The EU-level analysis identified several examples of specific expertise that companies will need (or already need) to keep up with innovations in the field, including CRISPR-based diagnostics, protein structure solutions, genome sequencing and precise genome manipulation, quantum simulation and spatial multi-omics. The occupational profiles

[82] We define high-skilled occupations as ISCO occupational groups 1, 2, and 3. Lower-skilled occupations refer to ISCO occupational groups 4, 5, 6, 7, 8 and 9.
[83] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.
[84] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.

in demand will be expected to combine these specific skills with a general understanding of agronomy.

Even though the emphasis on these highly specialised high level-skills in the Western Balkan companies was weaker than in the EU, several interviewed stakeholders did emphasise the growing importance of, for instance, physicochemical analyses and genetic engineering. They all require very specialised and high-level qualifications, involving work with specialised equipment. Stakeholders also emphasised that the specialist skills will need to be updated frequently because rapid advancement of technology renders them obsolete.

The areas of research and production that relate to the biochemical and microbial products for agri-food are mentioned in the smart specialisation documents of all Western Balkan economies, although not necessarily in the context of food production (see the table overleaf). For example, in Albania, microbiology, environmental science and as well as agricultural and biological sciences are recognised as fields with high scientific potential in the country, although without references to modernisation of agriculture and food processing. Similarly, in Kosovo and Montenegro, these areas were identified as fields with high shares of scientific publications. Meanwhile, in North Macedonia and Serbia – the two countries in which the activities of the biochemical and microbial niche are the most visible – the smart specialisation strategies mention the production of mineral and microbiological fertilisers, as well as biological and chemical agents for combating pests and diseases among the smart agriculture priority sub-areas. Overall, this indicates that skills in the broad fields of biology and chemistry applicable in this niche will remain relevant across the whole Western Balkan region, with their specific application to the development and production of fertilisers in PPPs, especially in Serbia and North Macedonia.

Table 9. Key areas, related occupations in Western Balkans and the EU, and country-specific priorities

Area	Related ESCO occupations	Country-specific priorities
Biology, biotechnology, chemical technology, and genetics	bioinformatics scientist (2131.3) geneticist (2131.4.8) biophysicists (2131.4.4) microbiologist (2131.4.10) biology technician (3141.2.3) bacteriology technician (3141.2.1) chemist (2113.1) biochemist (2131.4.2) biochemical engineer (2145.1.1) chemistry technician (3111.1) biochemistry technician (3141.2.2) chemical engineering technician (3116.1) chemical processing plant controller (3133.1)	**Albania**: microbiology (and immunology) is identified as one of the fields with high scientific potential in the country[85] **Kosovo**: biochemistry, genetics and molecular biology are among the fields with a high share of scientific publications[86] **Montenegro:** agricultural and biological sciences are identified as one of the fields with a high share of scientific publications[87] **North Macedonia:** production of mineral and microbiological fertilisers and biological and chemical agents for combating pests and diseases is mentioned as a part of Smart Agriculture priority sub-area[88] **Serbia**: production of mineral and microbiological fertilisers and biological and chemical agents for pest and disease control is mentioned as a part of the High-tech Agriculture priority sub-area. Moreover, molecular genetics is recognised as one of the modern technologies in this sub-area. Biotechnology is identified as sub-area within the Key Enabling Technologies priority area, demonstrates high scientific potential and, together with agriculture, has the highest number of patents [89]
Environmental science	ecologist (2133.5) environmental expert (2143.2) environmental programme coordinator (2133.6) environmental engineer (2143.1)	**Albania**: environmental science is identified as one of the fields with high scientific potential in the country[90] **Kosovo**: environmental science is identified as one of the fields with a high share of scientific publications[91] **Montenegro:** environmental protection is identified as a new specialisation field in scientific research. Energy and sustainable environment is one of the smart specialisation priority domains[92]

[85] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[86] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[87] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[88] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[89] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[90] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[91] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[92] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.

Area	Related ESCO occupations	Country-specific priorities
		North Macedonia: production of mineral and microbiological fertilisers and biological and chemical agents for combating pests and diseases is mentioned as a part of Smart Agriculture priority sub-area[93] **Serbia**: production of mineral and microbiological fertilisers and biological and chemical agents for pest and disease control is mentioned as a part of High-Tech Agriculture priority sub-area[94]
Agriculture, agronomy and veterinary science	agricultural scientist (2132.1) agronomist (2132.2) soil scientist (2133.11) agricultural engineer (2144.1.2) general veterinarian (2250.6) veterinary technician (3240.2) agricultural technician (3142.1)	**Albania**: agricultural and biological sciences are identified as one of the fields with high scientific potential in the country[95] **Kosovo**: agricultural and biological sciences are identified as one of the fields with a high share of scientific publications[96] **Montenegro:** Sustainable Agriculture and Food Value Chain is a priority area for smart specialisation. Agricultural and biological sciences are identified as one of the fields with a high share of scientific publications, while agriculture and food production as an area with high scientific potential[97] **North Macedonia:** Smart Agriculture is a sub-area within Smart Agriculture and Food Processing with High Added Value priority domain for smart specialisation[98] **Serbia**: agriculture is a central part of the Food for the Future priority area and, together with biotechnology, has the highest number of patents [99]
Food technology	food biotechnologist (2131.5) food technologist (2145.1.4) food analyst (3111.3)	**Albania**: manufacture of other food products (NACE C10.8) is identified as an industry with high economic potential[100] **Kosovo**: food processing is identified as a preliminary priority area for smart specialisation[101] **Montenegro:** agriculture and food production is identified as an area with high scientific potential[102] **North Macedonia:** Smart Agriculture and Food Processing with High Added Value is selected as a potential priority area for smart specialisation, while manufacture of other food products (NACE C10.8) is identified as an industry with high economic and scientific potential[103]

[93] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[94] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[95] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[96] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[97] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[98] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[99] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.
[100] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[101] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[102] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[103] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.

Area	Related ESCO occupations	Country-specific priorities
		Serbia: food production is a central part of the Food for the Future priority area for smart specialisation. Structural transformation of the agri-food sector from agriculture to food processing is mentioned as a key priority in the Value-Added Food Products sub-area[104]

Note: No smart specialisation publications that outline country priorities were available for Bosnia and Herzegovina

[104] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Business development-related occupations and skills

Overall, the most problematic unsatisfied skill demand in the biochemical and microbial niche was identified in the areas of **business development** and **internationalisation.** This was strongly emphasised by producers in Serbia and North Macedonia, as well as Albania by companies focused on imports. Knowledge and skills, necessary for the commercialisation of products (i.e. sales, marketing, and management skills) are hard to find and recruit for these companies, also because of salaries that are lower than in other innovative sectors (e.g. ICT).

At the same time, start-up representatives highlighted these occupational profiles as most important for them in accelerating the commercialisation and market expansion. A specific role which companies from Serbia, North Macedonia and Kosovo found hard to fill was that of specialists who could bring in new technologies into their company operations and modernise the production processes, and support commercialisation and internationalisation. Some companies, e.g. in Kosovo, address this by hiring foreign consultants rather than domestic recruitment.

Overall, based on the occupations and skills mentioned by interviewees and then linked to the ESCO classification, the sought-after occupations in **sales and marketing** areas include financial managers (ESCO 1211.1) and marketing managers (ESCO 1221.3.2 and 1221.5), as well as sales representatives (ESCO 2433.6 and 3322.1). Based on the specific skill needs mentioned, companies also require marketing specialists, such as marketing consultants (ESCO 2431.10) and market research analysts (ESCO 2431.11). The skills in **internationalisation** often mentioned by interviewees relate to the occupations of export managers (ESCO 1324.3.2) and import-export specialists (3331.2.1).[105] Finally, **communication** and **customer care** is another important area for some of the interviewed businesses in the Western Balkans. In addition to sales representatives and managers mentioned above, these skills can also be addressed by occupations such as communication managers (ESCO 1222.1), client relations managers (2431.6) and customer service representatives (4225.1).[106]

Box 7. Business support occupations demanded in the biochemical and microbial products market niche in the Western Balkans

Internationalisation	
• import export manager (ESCO 1324.3.2)	• import export specialist (3331.2.1)
Marketing and sales	
• marketing manager (1221.3.2)	• technical sales representative (2433.6)
• digital marketing manager (1221.5)	• commercial sales representative (3322.1)
• communication manager (1222.1)	• marketing consultant (2431.10)
	• market research analyst (2431.11)
Financial management	
• financial manager (1211.1)	
Communication and customer care	
• communication manager (1222.1)	• customer service representative (4225.1)
• client relations manager (2431.6)	

Most of these occupations belong to the high-skilled ISCO groups of managers (ISCO 1) and professionals (ISCO 2), and therefore typically require education at ISCED level 5 or higher.

The interviewed stakeholders in all Western Balkan economies also emphasised that they face difficulties in finding and recruiting personnel combining occupation-related skills with cross-cutting

[105] Based the ESCO classification of Skills, Competences and Occupations. Detailed information on skills and knowledge required for these occupations is presented in Annex 3. ESCO occupational profiles and skills.
[106] Based the ESCO classification of Skills, Competences and Occupations. Detailed information on skills and knowledge required for these occupations is presented in Annex 3. ESCO occupational profiles and skills.

capabilities, such as motivation for personal development, teamwork, and effective communication. Speaking different languages is one of the essential skills for import export professionals based on the ESCO database. Language skills, and English in particular, was often emphasised by companies that focused on exports.

In the EU biochemical and microbial companies, the demand for similar occupational profiles exists as well, including for business analysts (2421.1), logistics analysts (2421.5), commercial sales representatives (3322.1), import-export specialists in agricultural raw materials, seeds and animal feeds (3331.2.1.2), import-export specialists in chemical products (3331.2.1.4), and supply chain assistants (3343.1.7). In addition to this, the analysis in the EU revealed a more pronounced demand related to the increasing company size, such as human resources officers (2423.3), training and staff development professionals (2424), public affairs consultants (2432.8), contract managers (2619.1), legal consultants (2619.7), and regulatory affairs managers (2619.12), among others.[107]

Overall, occupational profiles in **sales and marketing**, **business development, communication** and **internationalisation** more broadly, as well as **administrative and human resources** roles, are likely to be increasingly in demand with the growing demand for biochemical and microbial products and the growth of producer companies. However, looking at the trends in the development of biochemical and microbial companies in the Western Balkan region, this is most likely to affect primarily Serbia and (to some extent) North Macedonia.

Skill supply

The companies developing and producing biochemical and microbial products for agri-food, both in the EU and the Western Balkan region, mostly emphasise the demand for highly qualified workforce, with specific expertise in the various subfields of chemistry and biology. University level education, therefore, is usually a key requirement for potential hires in small start-ups. Meanwhile, adult and on-the-job learning were emphasised as a necessity in securing the right skills profiles for the companies' operations.

Initial vocational education and training

VET programmes potentially relevant to the field exist in Serbia and North Macedonia – economies in which the biochemical and microbial products niche is the most active – although to a different extent. For instance, in North Macedonia, VET schools offer curricula related to production and application of fertilisers, pesticides and nutrition products for animal feed, such as Agrotechnicians, Technicians in phytomedicine and Technicians in veterinary. In Serbia, only one relevant programme was identified: Manufacturer of chemical products. In Kosovo, a VET programme on plant protection is available. In Albania and Montenegro, although the companies developing and manufacturing biochemical and microbial products for agriculture were not identified, several schools exist that provide VET training in the relevant fields, such as for food technology technicians, environmental protection technicians and chemical technology technicians (a detailed list of the VET training offer by country is provided in Annex 4). However, the enrolment numbers are low. For example, in 2022 in Albania there were 13 students enrolled in VET Chemical technology programmes, out of 16 441 VET students in total.[108] Data for other Western Balkan economies were not available.

Nevertheless, the existing VET curricula in the mentioned occupations do not seem to be directly relevant to the specific interviewed companies. To illustrate, Serbian companies expressed a view that secondary vocational schools, despite all the shortcomings of the educational system, do offer students practical knowledge that they can later valorise on the market. However, stronger cooperation between companies and secondary schools is still missing, primarily due to the absence of specific curricula that offer courses on biochemical and microbial subjects. Similarly, representatives of North Macedonian companies expressed the concern that the curricula do not offer the right set of skills needed in their companies.

[107] Based on the job postings analysis done for the EU trends report.
[108] National Agency of Employment and Skills, 2022.

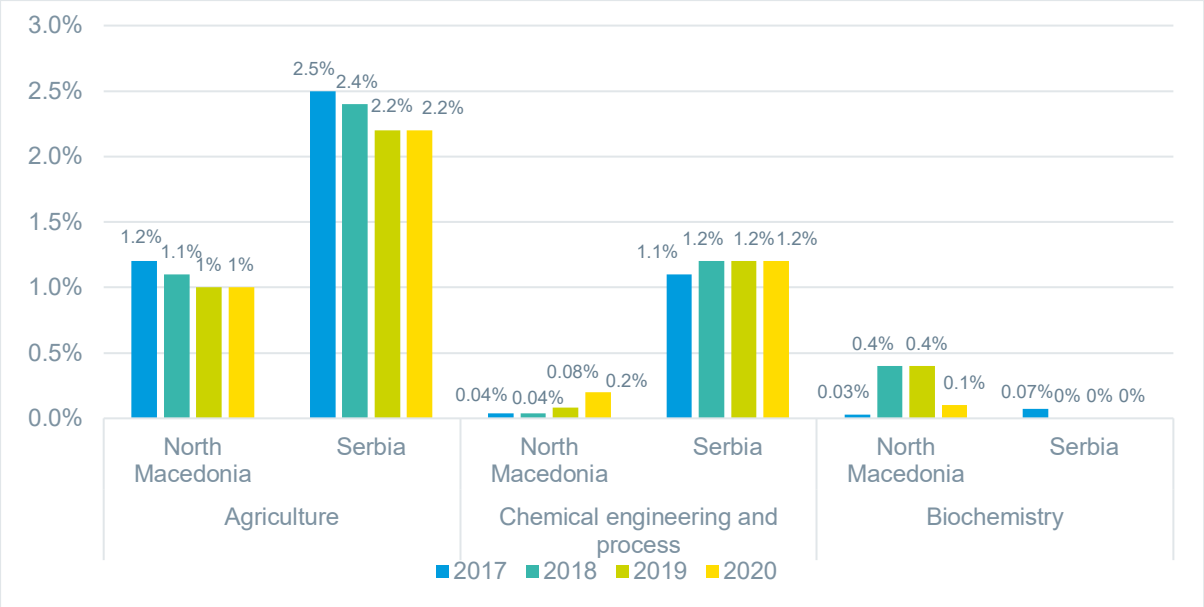
The inappropriateness of education curricula is, at least in part, related to the issue of insufficient stakeholder cooperation in the area of skill needs' identification and development. While some collaboration with Chambers of Commerce various hubs and accelerators exists in Serbia, North Macedonia and Albania, it is mostly limited to an exchange of information rather than matters related to human resource development. The interviewees especially emphasised the lack of collaboration between businesses and VET providers and other education institutions. International projects and donors involved with business stakeholders who could facilitate such exchanges in the relevant kills areas are rare or do not exist in most Western Balkan countries. Several interviewed companies expressed a wish for more collaboration with education providers, starting from the secondary level (which is important to ensure the influx of younger work force into the market).

Higher education

For most interviewed companies engaged in the development and manufacturing of biochemical and microbial products for agri-food, university level education is a necessary precondition for employment. All Western Balkan economies have universities that offer relevant study programmes (e.g. biology, biotechnology, chemistry; see a detailed list in Annex 4. Education and training programmes at VET and university levels).

Available data demonstrate that the share of students in tertiary programmes in agriculture has been decreasing in North Macedonia and Serbia between 2017 and 2020 (see Figure 16). Low but stable levels of enrolment have been posted for programmes in chemical engineering and process, as well as biochemistry, in the same period.

Figure 16. The share of students enrolled in tertiary programmes in agriculture, chemistry engineering and process, and biochemistry



Source: shares calculated based on Eurostat [EDUC_UOE_ENRT03]

Most interviewed businesses reported being largely satisfied with the level of technical skills provided in universities in these fields, although they noted that better preparation for the labour market in the practical application of skills would be desirable. Stakeholders from North Macedonia stood out in this context as they were rather sceptical about the quality of higher education in the relevant fields provided in the country. They suggested that the supply of workers in the biochemical and microbial niche is characterised by a severe deficit, as those sectors are less present in the country and the profiles offered by educational providers are limited to a small number of graduates.

Several interviewed companies from Serbia and North Macedonia noted that they collaborate with higher education institutions and research centres. For instance, in North Macedonia, enterprise Bioengineering signed a memorandum of cooperation with the Institute of Biology of the St. Cyril and

Methodius University in Skopje. The memorandum stipulates cooperation in internships and applying for joint research proposals. It also includes provisions on student training such as working with equipment and instruments owned by the company (e.g. instruments for DNA sequencing). In Serbia, the start-ups B-Fresh[109] and Biofor Solutions[110] have been established as spin-offs of collaborations in support of research institutes and higher education institutions.

On-the-job learning in companies

Given the lack of practical experience and immediately applicable skills of recent graduates (both VET and tertiary education) who apply for the jobs in the companies, the companies reported that they must provide in-house training, or even outsource training to other partners during the onboarding process of the operations personnel. The Serbian interviewees emphasised that investment in the education and skill development of their employees is also driven by the strong competition in attracting new personnel from the market. Overall, the interview data suggest that learning on-the-job is an especially relevant form of learning in SMEs engaged in the development and production of the biochemical and microbial products for agri-food.

Most interviewed companies explained that they provide on-the-job training in-house. New employees have probation periods of half a year and more, when the training is most intensive. In some cases, the employees also receive learning opportunities in companies that they cooperate with, or through cooperation with intermediary organisations, such as the Chamber of Commerce in Serbia. In-company training is also provided in Kosovo and North Macedonia, where companies emphasised the need to provide their employees with comprehensive on-the-job training in order for them to be able to work – and for which they often do not receive any outside support.

Non-formal and informal training offer

The provision of non-formal and informal training on the development and production of biochemical and microbial products for agri-food is virtually non-existent in the Western Balkans. Only sporadic instances of trainings on topics directly related to the niche (microorganisms for agri-food, chemistry) were identified in Serbia and Montenegro. Nevertheless, there is a large amount of training on the application of such inputs in agriculture and food processing. These are presented in more detail in the following section on organic agriculture.

Table 10. Non-formal and informal training in key areas

Area	Identified non-formal/ informal training offer
Biology, biotechnology, chemical technology, and genetics	▪ **Montenegro**: training on effective microorganisms (EM) technology by the Agricultural Cluster of Montenegro ▪ **Serbia**: training in chemistry, agriculture and food production at the Zabela penitentiary offered as part of the EU-funded project 'EU Support to Reform of Education in Serbia – REDIS 2030'
Agriculture (including sustainable agriculture), agronomy and veterinary science	▪ See Table 20
Food technology	▪ See Table 20

Challenges in skill matching

The niche of development and manufacturing of biochemical and microbial products for agri-food is the most developed in Serbia, followed by North Macedonia. While some related activities are

[109] B-Fresh team was initially formed through research at the Institute for Multidisciplinary Research in Belgrade.
[110] Biofor Solutions developed out of a series of publicly funded research projects from the Ministry of Science and Technological Innovation at the Faculty of Agriculture in Zemun.

emerging in Kosovo as well, they have not been identified at all in Albania, Montenegro and Bosnia and Herzegovina. Therefore, the insights come from three economies of the region, in all three several weaknesses that create problems in the skill supply could be found (see the table below).

Table 11. Challenges in skills matching in the digitalisation for agri-food niche

	Level of niche development	Main issues in skills matching
Development and manufacturing of biochemical and microbial products for agri-food		
AL	No developer / producer companies identified. Main focus on imports and applications in agriculture.	Shortage of specialists in agronomy, agriculture, and agrarian economics due to the low popularity of these study programmes.
BA	No developer / producer companies identified.	No particular issues identified due to the absence of related economic activities in the country.
XK	Niche is very small, with few business opportunities and low commercialisation potential.	Lack of practical and technical skills in biotechnology and food technology. The VET and university education programmes suffer from old equipment, a lack of funding for innovative educational practices and outdated educational practices.
ME	No developer / producer companies identified. Main focus on imports and retail.	No particular issues identified due to the absence of related economic activities in the country.
MK	The developer and producer companies are emerging, but their activities remain small scale.	Outdated skills of employees are an obstacle for modernising production processes and expanding the markets. Universities do not offer the necessary educational and training of demanded skills profiles, such as genetics engineers, microbiologists and biochemical engineers knowledgeable of the latest technological developments.
RS	The activities of development and manufacturing of biochemical and microbial products for agri-food are the most developed and active in the region.	University programmes lag behind the recent technological developments and market needs, particularly in the knowledge of business development and practical work at companies. In VET, cooperation between companies and secondary schools is missing, while specific curricula that offer courses on the biochemical and microbial knowledge are absent.

Stakeholders noted that for certain occupational profiles it is especially hard to recruit, which creates obstacles for the overall development of the niche. For instance, companies look for skills for industry 4.0: a combination of food technology, chemistry or biology knowledge and its application using modern ICT tools. Technological developments in these areas are likely to further increase the demand for sophisticated specialist skills, that also involve the use of modern equipment and the newest technologies in natural sciences.

Relevant university study programmes in the broad fields of chemistry and biology, and in areas related to business development, are available in Western Balkans. However, skills that recent graduates have are usually theoretical and lack practical experience to be immediately deployed in companies. The region's stakeholders linked this to the overall outdated nature of the higher educational system, which is sometimes viewed as unable to adapt educational programmes to the pace of technological development and needs of the market. In some countries, like Kosovo, stakeholders even talked about 'overproduction' of university graduates with insufficient skills for the current labour markets.

In countries in which companies representing the biochemical and microbial product niche operate, the necessary skills are gained on the job and require considerable investment from the hiring companies. In other countries, this is an obstacle for the development of such activities. In Albania, for instance, the lack of skilled workers in the agriculture, forestry, fisheries, and veterinary sciences sectors means, according to interviews, that the country is ill-equipped to take up new technological trends and allow the biochemicals sector to develop.

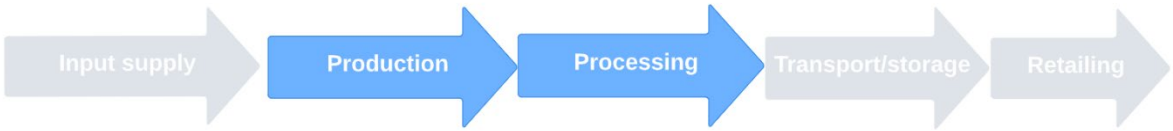
Meanwhile, VET programmes in the fields related to developing and manufacturing biochemical and microbial products for agri-food exist in Serbia and North Macedonia, where this niche is the most developed. Nevertheless, the existing VET curricula do not seem to be relevant to the interviewed companies. At the same time, some of the interviewed SMEs did acknowledge that the practical knowledge provided through VET could be very valuable on the labour market. To seize this opportunity, closer cooperation between companies and secondary schools is needed, to create specific curricula that offer up-to-date skills for the companies that develop or manufacture biochemical and microbial products for agri-food.

Organic foods

Overview

Companies that are active in the organic foods market can operate at all levels of the agri-food value chain, including input supply, production, processing, transportation/ storage and wholesale/ retail levels. These companies engage in producing inputs, such as organic seeds and biofertilisers, growing raw agricultural products, processing the raw products to manufacture food and beverages, and bringing the final products to sellers and consumers. The focus of this study was specifically on the companies that are active on the production and processing levels of the agri-food value chain (see Figure 17).

Figure 17. Organic foods market niche within the agri-food value chain



Organic food production should respect natural life cycles. Organic regulations prohibit or restrict the use of certain practices in food production (e.g. the use of GMOs, ionising radiation, artificial fertilisers, herbicides and pesticides, hormones and antibiotics for animal health) and the number of food additives, and limit substantial changes to food.[111] The EU regulations on organic production exclude products from fishing and hunting of wild animals, but include the harvest of wild plants when certain natural habitat conditions are respected, as well as products from aquaculture.[112] Organic food production, therefore, falls under the following NACE sectors:

- Growing of non-perennial crops (A1.1).
- Growing of perennial crops (A1.2).
- Plant propagation (A1.3). Animal production (A1.4).
- Mixed farming (A1.5).
- Support activities to agriculture and post-harvest crop activities (A1.6).
- Aquaculture (A3.2).

Organic food production and processing are part of the wider agricultural and food-processing industries, which are among the most important industrial sectors in the EU and globally. The global **organic food and drink** sales amounted to more than EUR 120 billion in 2020.[113] The largest markets were the United States (EUR 49.5 billion) with 41% of the global market, Germany (EUR 15 billion) and France (EUR 12.7 billion). The EU-27 contributed to 37% of the global market (EUR 44.8 billion).[114] The COVID-19 pandemic has impacted the growing demand for healthy nutrition by positively affecting the sales of organic and functional food.[115]

[111] European Court of Auditors (2018). Organic Food in the EU. Available here.
[112] European Commission (2022). Organic production and products. Available here.
[113] FiBL & IFOAM – Organics International. The World of Organic Agriculture: Statistics & Emerging Trends 2022. Available here.
[114] FiBL & IFOAM – Organics International. The World of Organic Agriculture: Statistics & Emerging Trends 2022. Available here.
[115] Euromonitor International (2021). Changing Attitudes in Health and Nutrition: Rise of Immunity-Boosting Strategies. Available here.

The Organic action plan, developed by the EU to achieve the goals of the European Green Deal to have at least 25% of the EU's agricultural land under organic farming, and significantly increase the volume of organic aquaculture by 2030, further incentivises producers to turn to organic food production.[116] To promote the growth of the organic sector, the EC plans to devote 30% of research and innovation funding for agriculture, forestry and rural areas to topics relevant to the organic sector.[117]

Compared to the EU, the scale of activities of organic food production and processing remains considerably smaller in the Western Balkans. While in the EU the average share of organic land is 9.1%, in the Western Balkan region it ranges between 0.1% to 1.9%. Montenegro has the largest share of agricultural land devoted to organic production (see the table below). Meanwhile, in absolute terms of the total organic land area, Serbia is leading the table (19 317 ha), followed by Montenegro (4 823 ha), and North Macedonia (3 727 ha).

Table 12. Shares of organic land in the total agricultural land

Country	*Montenegro*	*Serbia*	*Kosovo*	*North Macedonia*	*Albania*	*BiH*	*EU-27*
Share	1.9%	0.6%	0.4%	0.3%	0.1%	0.1%	9.1%

Source: Western Balkan countries – FiBL – IFOAM Organic International (2022).[118] EU-27 – Eurostat (org_cropar)

Note: Agricultural land includes in-conversion areas and excludes wild collection, aquaculture, forest, and non-agricultural grazing areas.

The available statistics show that in the past ten years, the growth of organic agricultural land area has been positive in the majority of Western Balkan countries except for North Macedonia (see Table 13). Compared to the average growth of 68% in the EU, the Western Balkan region has been showing considerable progress, and the majority of countries' growth figures are above the EU average. Kosovo is leading with the highest relative growth, related to the fact that the organic agriculture activities have only been emerging in the country during this period. It is followed by Bosnia and Herzegovina (394%), Serbia (210%) and Albania (98%). North Macedonia is the only country where the share of organic land has been shrinking (-86%).

Table 13. 10-year growth of organic agricultural land (2010-2020) in % and in ha

Country	*Kosovo*	*BiH*	*Serbia*	*Albania*	*Montenegro*	*North Macedonia*	*EU-27*
10-year growth (%)	14,351%*	394%	210%	98%	57%	-86%	68%
10-year growth (ha)	1,593	1,349	13,080	439	1,755	-22,704	n/a
Organic land area in 2010 (ha)	11	343	6,237	448	3,068	26,431	n/a
Organic land area in 2020 (ha)	1,604	1,692	19,317	887	4,823	3,727	14,724,279

Source: FiBL – IFOAM Organic International (2022);[119] Eurostat (org_cropar).

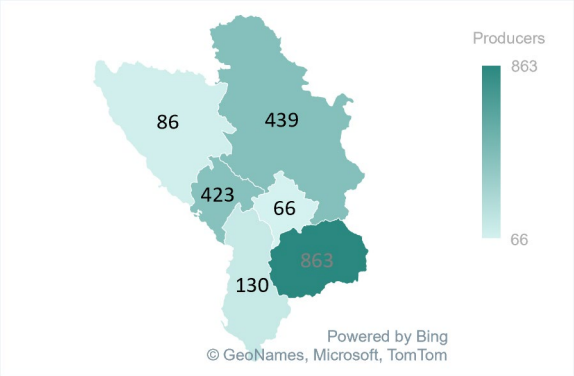
Note: Agricultural land includes in-conversion areas and excludes wild collection, aquaculture, forest, and non-agricultural grazing areas. * Please note that the change is calculated against a very low base of organic land area in 2010.

Based on the latest available data for 2020, the largest number of **organic producers** in the region were in North Macedonia (817), followed by Montenegro (423), and Serbia (373) (see Figure 18). Compared to the neighbouring EU countries, the number of organic producers in the Western Balkans is considerably lower: in 2020, Croatia, Bulgaria and Hungary had over 5 000 organic producers

[116] European Commission (2022). Organic Action Plan. Available here.
[117] European Commission (2022). Organic Action Plan. Available here.
[118] FiBL & IFOAM – Organic International (2022). The World of Organic Agriculture: statistics & emerging trends 2022. Available here. Data in the report is based on the FiBL survey 2022, based on information from the private sector, certifiers, and governments. Calculation of organic shares based on FAOSTAT, Eurostat, and national sources.
[119] FiBL & IFOAM – Organic International (2022). The World of Organic Agriculture: statistics & emerging trends 2022. Available here. Data in the report is based on the FiBL survey 2022, based on information from the private sector, certifiers, and governments. Calculation of organic shares based on FAOSTAT, Eurostat, and national sources.

each.[120] When it comes to the numbers of organic food processing companies, Serbia dominates in the region with 101 certified companies in 2020, followed by Bosnia and Herzegovina (51) and Albania (46) (see Figure 19). Compared to the EU, the Western Balkan economies have a relatively lower number of processors of organic products, however, the gap is not as pronounced as in the case of organic producers. For comparison, in 2020, the neighbouring Hungary had 458 processors of organic products, Croatia – 322, Bulgaria – 241, while Romania had only 183.[121]

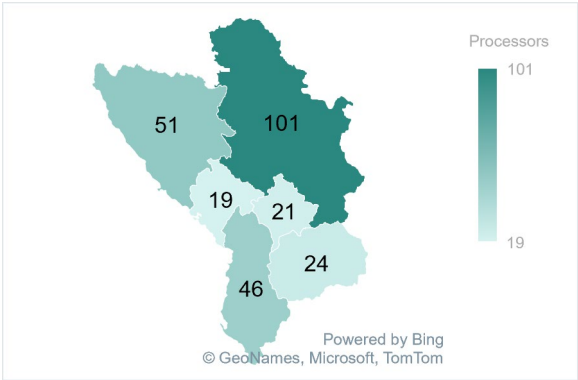
Figure 18. The number of organic producers in Western Balkan countries (2020)



Source: Own representation based on data from the FiBL & IFOAM – Organic International (2022). The World of Organic Agriculture: statistics & emerging trends 2022. Available here.

Note: The data for BiH is for 2019.

Figure 19. The number of organic processors in Western Balkan countries (2020)



Source: Own representation based on data from the FiBL & IFOAM – Organic International (2022). The World of Organic Agriculture: statistics & emerging trends 2022. Available here.

Note: The data for BiH is for 2019.

In most of the countries in the region, specialty crops, specifically **fruits and vegetables,** are the most produced organic foods. In some countries, fruits and vegetables are also central to the food processing sector (see the box below).

Box 8. Main organic food products of Western Balkan economies

- In **Serbia**, both the production and processing of fruits and vegetables is central in the niche. Out of the total number of organic processors in 2020, the largest number was engaged in processing and preserving of fruit and vegetables (54.46%).[122]
- In **Bosnia and Herzegovina**, fruit and vegetable production and processing are central in the agri-food sector in general. Producers focus on growing various types of fruit and vegetables, while the processing companies specialise in drying fruits and producing fruit juices, concentrates and preserves, as well as pickled vegetables and gherkins. Favourable conditions for growing domestic grapes also serve as a basis for the development of wine production.[123]
- In **Montenegro**, fruits and vegetables, in particular apples, plums, and potatoes, are among the most certified organic products, while the most produced processed organic foods are chokeberry and apple juice.[124]
- In **North Macedonia**, the leader in the number of organic producers, many local farmers and small businesses offer organic fruits and vegetables and other products, including cereals, honey, meat, and dairy.[125]
- In **Kosovo**, raspberries and blueberries are among the main organic products together with wild collections of non-wood forest products and medicinal and aromatic plants (MAPs).[126]

[120] Based on Eurostat (2022). Organic operators by status of the registration process.
[121] Based on Eurostat (2022). Processors of organic products by NACE Rev. 2 activity (C).
[122] Eurostat (2023). Processors of organic products by NACE Rev. 2 activity (C).
[123] Foreign Trade Chamber of Bosnia and Herzegovina:Business sectors. Available here.
[124] Programme for Development of Agriculture and Rural Areas in Montenegro under IPARD IIII 2021-2027, Ministry of Agriculture, Forestry and Water Management, 2022.
[125] Based on the North Macedonia country report.
[126] EkoConnect (2022). p. 7. Available here.

- In **Albania**, in contrast to the rest of Western Balkan states, the organic food production is largely represented by MAPs. Although the country has a long tradition of winemaking and posts strong numbers in the production of olives, fruits (chestnuts, forest fruits), and the development of orchards, MAPs dominate the sector, making up around 85% of the total organic production in Albania.[127]

The organic food businesses that were interviewed within the framework of this study were all locally owned SMEs (see Annex 2 for more details on the companies). These companies produced a wide range of products: fruits (especially berries), vegetables, medicinal and aromatic plants, honey, meat, dairy, as well as processed foods and drinks including olive oil, herbal teas, juices, jams, syrup, functional snacks and beverages, and food supplements.

The organic food segment of the niche is heavily export-oriented in most of the Western Balkan economies. To illustrate, Serbia currently exports over 99% of its organically produced food, with around 90% of the exports going to the EU.[128] Among the interviewed companies, many actively export, and some are still planning their export activities. The export geography of these companies spans from other Western Balkan countries and Western Europe to the US, Canada, Japan, and Australia.

Others, however, reported issues with lengthy and demanding processes of product certification and the achievement of standards for target markets. To illustrate, in Bosnia and Herzegovina, one of the interviewed companies exports its products to Germany, while another company is preparing to start exporting to Serbia, the Netherlands and Sweden in 2023. By the time of data collection, the latter company was postponing its internationalisation, due to the limited resources slowing down the certification process. In Montenegro, the interviewed companies were mainly selling their products on the local market, and only one company exported to Slovenia, Sweden and Germany, although there was ambition to grow and enter other Western Balkan markets. These companies shared that they faced similar obstacles in expanding to the international markets: certification and approval of products are very slow processes and require significant amounts of time and financial resources, while the processes for obtaining funds fall behind as well.

Overall, and nevertheless, the production and processing of organic foods constitute a particularly promising niche within the agri-food sector. The demand for organic food products is projected to grow globally, including in the EU[129] to where Western Balkan economies actively export.[130] This presents an opportunity to Western Balkan economies to develop the production of organic food for export.

This opportunity is recognised within the region. For instance, in Montenegro, the 2019-2024 Smart Specialisation Strategy foresees support to the transition from traditional to organic farming by using innovative approaches of natural resource management.[131] In Serbia, the largest Western Balkan economy, the national Smart Specialisation strategy mentions the big potential organic products, with an emphasis on shifting from certified primary agricultural products to processed organic products (frozen or dried organic products, organic dairy products, etc.).[132] In this regard, one of the key opportunities for the region's agri-food sector is to enhance the food production chain, by transforming from exporters of raw agricultural produce into exporters who also supplies processed food products.

[127] INSTAT (2021). Statistical yearbook. Available here.
[128] Available here.
[129] Meier, C. D., Siorak, N., Bonsch Buri, S., & Cornuz, C. (2015). Sustainable Supply Chains and Environmental and Ethical Initiatives in Restaurants in P. Sloan, W. Legrand, & C. Hindley (Eds.), The Routledge Handbook of Sustainable Food and Gastronomy. London: Routledge; PWC (2021). Vitamins & Dietary Supplements Market trends – Overview. Available here.
[130] FiBL (2022). Exceptional growth of the European organic market 2020
– Organic market reaches 52 billion euros and organic farmland 17 million hectares in 2020. Available here.
[131] Available here.
[132] Government of the Republic of Serbia. (2020). Smart Specialization Strategy. Belgrade: Ministry of Education, Science and Technological Development, Republic of Serbia. Available here.

The legislation regulating organic foods is fully implemented in all Western Balkan economies except for Bosnia and Herzegovina,[133] where the process is still ongoing with the relevant by-laws being passed.[134]

Skill supply and demand

Employment profile

Statistics on the number of employed people in the organic food production and processing market niche are not collected in any of the Western Balkan economies. Therefore, we use statistics on the broader agricultural production and food processing sectors to get an insight into the significance of this sector in overall employment in each economy.

Based on the LFS data for 2021, the share of employed (out of total employment) in agriculture, forestry and fisheries was the highest in Albania at nearly 34%, followed by Serbia (15%) and North Macedonia (11.8%). For all economies for which the data is available, the broad manufacturing sector prevails, except for Albania.

Table 14. The share of employed in broader sectors relevant for the organic food niche, LFS, 2021

	Albania	*Bosnia and Herzegovina*	*Kosovo*	*Montenegro*	*North Macedonia*	*Serbia*
Total employment	1,248,749	1,151,000	386,870	212,600	693,494	2,848,800
A – Agriculture, forestry and fishing	33.8%	9.4%	2.8%	6.4%	11.8%	15%
C – Manufacturing	11.2%	n/a	10.3%	6%	19.2%	n/a

Source: National statistics offices of Albania, BiH, Kosovo, Montenegro, North Macedonia and Serbia.

The table below presents data on registered employment, which is more granular compared to LFS data and it tends to underestimate the number of workers and does not take into account informal employment[135]. It shows that in Montenegro, North Macedonia and Serbia, the share of people employed in manufacture of food products ranges between 2.2% and 4.2% of the total employment. The share of those employed in the beverages manufacture is much smaller, and varies between 0.2% and 0.4%. The total share of these agri-food sectors (A1, A3, C10 and C11) in the total employment is 3.3% in Montenegro, 5.3% in North Macedonia, and 5.7% in Serbia.

Table 15. People employed in sectors relevant for the organic food niche as a share of total employed, registered employment, 2021

	Montenegro	*North Macedonia**	*Serbia*
Total employment	188,964	602,722	2,212,631
A – Agriculture, forestry and fishing	*1%*	*2.1%*	*1.3%*
A1 – Crop and animal production, hunting and related service activities	0.71%	1.62%	1%
A3 – Fishing and aquaculture	0.15%	0.1%	0.1%
C – Manufacturing	*6.2%*	*21%*	*22.3%*
C10 – Manufacture of food products	2.2%	3.2%	4.2%
C11 – Manufacture of beverages	0.2%	0.4%	0.4%

[133] FiBL & IFOAM – Organic International (2022). The World of Organic Agriculture: statistics & emerging trends 2022. Available here.
[134] The regulation exists only on the level of entities, i.e. there is no overarching national regulation.
[135] This is especially relevant for the agriculture, forestry and fisheries sector, which is characterised by the high shares of informal employment, including in the Western Balkans. The data on registered employment demonstrates significantly lower shares of employed in NACE sector A, as compared to LFS data (see the table below). At the same time, the shares of people employed in manufacturing do not differ that drastically between the two data sources (e.g. 19.2% according to LFS and 21% according to registered employment data in North Macedonia).

Source: statistical yearbooks of Montenegro, North Macedonia and Serbia. *Data for North Macedonia is presented for 2020 due to data availability.

The available information on the occupations within the broad NACE sector A (agriculture, forestry, and fishery) shows that the majority of workers employed in this sector belong to the occupational group of skilled agricultural, forestry and fishery workers (see the table below), mostly associated with vocational level qualifications.

Table 16. The share of employed in the agriculture, forestry, and fishery sector (NACE A) by occupational group, LFS, 2020

Occupational group (ISCO)	Montenegro	North Macedonia	Serbia
1 - Managers	n/a	0.94%	0.43%
2 - Professionals	n/a	1.26%	0.64%
3 - Technicians and associate professionals	n/a	1.88%	0.97%
4 - Clerical support workers	n/a	0.84%	0.36%
5 - Service and sales workers	n/a	1.15%	0.55%
6 - Skilled agricultural, forestry and fishery workers	76.97%	59.06%	86%
7 - Craft and related trades workers	n/a	0.84%	0.88%
8 - Plant and machine operators and assemblers	n/a	1.05%	1.92%
9 - Elementary occupations	15.76%	32.98%	8.26%
TOTAL	100%	100%	100%

Source: Eurostat (2023). Employment by sex, age, occupation and economic activity (from 2008 onwards, NACE Rev. 2) (1 000). Available here.

The interviewed companies active in the niche mainly employ local workforce on full-time employment contracts and are predominantly small or micro companies (only a couple of medium size companies were included in the interviews, please see Annex 2). Employees, apart from seasonal workers for agricultural activities, are usually educated at the ISCED 4 level and higher, meaning that they have at least some kind of post-secondary education. Large shares of employees have tertiary education. The gender of the owners of the selected companies is almost equally distributed, with men slightly prevailing.

Meanwhile, the average wages in the NACE sectors relevant to the organic food market niche are for the most part below the average salary in each economy (see Table 17). The beverages processing sector (C11) is a notable exception in most of the Western Balkan economies, where the average net salary is above the country's average.

Table 17. Average monthly income (net) in the Western Balkans, disaggregated by economic activities (in EUR for the total average salary, and in % of the total average salary for the specific activities), 2021

Country	Albania	BiH	Kosovo	Montenegro	North Macedonia	Serbia
Total average salary (EUR)	**462**	**509**	**432**	**532**	**465**	**561**
A Agriculture, forestry and fishing	65%	87%	62%	85%	80%	85%
A01 Crop and animal production, hunting and related service activities	n/a	65%	n/a	86%	80%	86%
A03 Fishing and aquaculture	n/a	66%	n/a	100%	73%	65%
C Manufacturing	86%	76%	78%	74%	85%	87%
C10 Food processing	n/a	73%	n/a	53%	80%	77%
C11 Beverages processing	n/a	107%	n/a	212%	119%	115%

Source: Statistical offices of the Western Balkan economies.

Note: All salaries are net. For Albania, there was no data for net salaries, so we recalculated the gross by using the tool available on the website for the Albanian General Directorate for Taxes, available here. Data on most salaries was available only in national currencies. Salaries were converted using the exchange rates for February 2023.[136]

Skill demand

Technical occupations and skills

The interviewed producers and processors of organic foods provided a list of specific skills and occupational profiles that are essential for their operations. In the process of analysis, the specific skills mentioned in the interviews were linked to occupations covering these skills within the ESCO classification.

To begin with, the interviewed producers of organic food commonly reported a need for specific knowledge related to **farming practices** in general and **organic farming** in particular. More specifically, agronomy and plant protection were most often cited as important knowledge areas by several companies across the region. Among the most sought-after skills in these areas are fertilisation, managing disease outbreaks, and pest control without the use of synthetic chemicals. Based on the ESCO classification, these skills are part of the skillset for occupations such as agronomists (ESCO 2132.2).[137] These skills are hard to find in some of the Western Balkan economies. In Kosovo, for instance, the interviewed companies emphasised that they had to rely on expertise in pesticide usage from abroad.

Knowledge of **organic standards, labelling and certification** processes are areas of expertise that are highly relevant, especially for the interviewed companies in Albania and Bosnia and Herzegovina, which find internationalisation and reaching the standards of the target markets particularly challenging. Specific knowledge areas include quality labels for organic products, such as protection of origin, indicators of origin and brand protection rules, and legal standards related to organic farming and organic products. The interviewed companies in the Western Balkans expect the need for knowledge and skills in these areas to grow in the future.

Knowledge related **to adaptation to climate change** was also mentioned by interviewees in the Western Balkans as increasingly relevant for organic producers. Interviewees named occupations relevant for sustainable production such as plant protection engineers, environmental experts (ESCO 2143.2), biotechnologists (2131.5), and ecologists (2133.5) as relevant for the future.

Furthermore, interviews showed a demand for expertise in **food technology** and **food safety**, especially in food processing companies. Based on ESCO, these knowledge areas are part of the skill profiles for occupations such as food safety specialists (2263.2), as well as for food technologists (2145.1.4), food technicians (3119.5), and food biotechnologists (2131.5).[138]

In addition to the food production and processing related skills, as the organic foods companies increasingly turn to digitalisation and automation, the corresponding skill needs emerge. This trend is noticeable both in the EU and in the Western Balkans. Knowledge of **digital technology** was named as important for companies in Albania, Bosnia and Herzegovina, Kosovo, Montenegro and North Macedonia. It should be noted that transformation in companies most often entails basic automation and digitalisation (e.g. keeping electronic records, operating production robots), hence digital skills are often required only at user level. At the same time, some interviewed companies use more advanced digital tools and therefore require knowledge of smart agriculture, and specific skills related to it, such as the ability to manage digital applications and sensors for monitoring and manipulation of environmental conditions. In the ESCO skills and competences database, skills in operating open-source software, using agricultural information systems and databases, and knowledge in e-

[136] Conversion rates for ALL to EUR are 116.12, see here; for BAM to EUR 0.51, see here; for MKD to EUR 61.7, see here and for RSD to EUR 117.32, see here. Kosovo and Montenegro use EUR.
[137] Other essential skills for these occupations are listed in in Annex 3. ESCO occupational profiles and skills.
[138] Other essential skills for these occupations are listed in in Annex 3. ESCO occupational profiles and skills.

agriculture are part of the skill profiles of agricultural scientists (ESCO 2132.1), agricultural engineers (2144.1.2) and horticulture production managers (6113.2).

Many of these occupations belong to ISCO groups of professionals (ISCO 2) and technicians (ISCO 3), and require education at ISCED level 5 and above.[139] Nevertheless, it is important to note that some businesses reported an unsatisfied demand for low-skilled manual jobs, which can be classified under the ISCO group of elementary occupations (group 9), and agricultural, forestry and fishery labourers' sub-group in particular (ISCO 921). Typically, the minimum educational requirement for such workers is ISCED level 1 (primary education).[140]

Moreover, the interviewed Western Balkan companies expressed high demand for occupational profiles, such as agricultural managers, such as farm managers (ESCO 6130.1), crop production managers (6114.1), and horticulture production managers (6113.2), as well as mixed farmers (6130), which usually need to be educated at ISCED levels 2-4.[141]

Finally, **operating machinery** was often mentioned by the interviewed organic producers as a required skill, this indicates a demand for such low-skilled occupations as land-based machinery operators (ESCO 8341.2) and food production operators (8160.34), among others. Based on the ESCO classification, operating agricultural machinery is also a part of the skill profiles of vineyard machinery operators (ESCO 6112.5), crop production managers (6114.1), agronomic crop production team leaders (6111.1), mixed farmers (6130.2), and elementary occupations such as crop production workers (ESCO 9213.1) and livestock workers (9212.4). Most of these occupations apart from elementary occupations (ISCO 9) require education at ISCED levels 2-4.[142]

While the detailed mapping of occupational profiles and skills reflecting the skills demand of the interviewed companies is presented in Annex 3, the table below summarises the key skills in demand mentioned in the interviews and corresponding ESCO occupations.

Box 9. Technical occupations relevant for organic food production niche based on companies' skill needs

Agriculture, agronomy, biology, and veterinary science	
Skills mentioned by companies	**Related ESCO occupations**
Agronomy Agro-economics Agricultural engineering Farm management Food safety Horticulture Organic farming Organic standards and certification Plant protection Smart/precision agriculture	**agricultural scientist (2132.1)** **agronomist (2132.2)** **agricultural engineer (2144.1.2)** **agricultural technician (3142.1)** **veterinary technician (3240.2)** agronomic crop production team leaders (6111.1) **crop production manager (6114.1)** **farm manager (6130.1)** **horticulture production manager (6113.2)** crop production worker (9213.1) **horticulture worker (9214.2)** **mixed farmers (6130)**
Environmental sciences	
Skills mentioned by companies	**Related ESCO occupations**
Adaptation to climate change Sustainable production	**ecologist (2133.5)** **environmental expert (2143.2)** **biotechnologist (2131.5)**
Food technology	
Food technology	**food biotechnologist (2131.5)**

[139] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.
[140] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.
[141] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.
[142] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.

Food safety Processing of organic products	**food technologist (2145.1.4)** **food safety specialist (2263.2)** **food technician (3119.5)**
Machinery operators and elementary occupations	
Operating machinery	land-based machinery operator (8341.2) vineyard machinery operator (6112.5) food production operator (8160.34)

Note: occupations in bold were mentioned by the interviewees directly. Others were specified by linking the skills mentioned in interviews to ESCO occupations.

While the organic food production and processing is at different stages of development in the EU and in the Western Balkans, similar skills trends are observed in both regions. For instance, in the EU, organic food companies demonstrate a similar demand for high-skilled profiles of agronomists (ESCO 2132.2), agricultural engineers (2144.1.2), food technologists (2145.1.4) and agricultural technicians (3142.1), among other occupations.[143]

In addition to these, due to the increasing levels digitalisation of the agri-food production in the EU, operator digital skills in areas such as robotics, automation, data management, digital security, general computer skills and e-commerce become more demanded for all occupational levels, including low-skilled occupations.[144] In the Western Balkans, the representatives of the companies, business intermediary bodies, and education and training providers have also highlighted the growing importance of digital and technological skills, including machinery operation and software knowledge, and the likely shortages of these skills in the future. With the growth of smart agriculture, it can be expected that there will be an increased need for professionals and technicians, who would apply and combine technology from various fields in order to optimise and increase yields, preserve the environment and reduce emissions of negative chemicals into the soil.

Furthermore, in both regions, demand for knowledge related to adaptation to climate change was mentioned by interviewees. As environmental awareness of companies and consumers grows and the governments continue fostering the green transition, knowledge related to sustainable production, carbon footprint, and animal welfare are likely become progressively more important.[145]

The importance of environmental science and environmental protection is also emphasised as areas of high scientific potential in the smart specialisation strategies of Albania, Montenegro and Kosovo. Serbia's strategic document, meanwhile, emphasises the greening of agricultural sector specifically, including through organic agriculture. This illustrates that the related skills are not likely to lose relevance in the future.

The importance of organic agriculture and processing of organic foods specifically also receives notable attention in the smart specialisation documents of four Western Balkan economies. As elaborated in the table overleaf, in Albania, the potential of organic production is recognised within the Agriculture, Fisheries, and Aquaculture priority domain. In Montenegro, strengthening the value chain of organic production is one of the sectoral goals. Meanwhile, the Serbian and North Macedonian governments mention organic foods among the elements of priority areas focused on high-added value products, shifting from primary agricultural products to processed foods. These strategic directions only emphasise the importance of securing the technical skills and occupations necessary for the development of the organic foods market niche in the longer term.

[143] Based on the job postings analysis done for the EU trends report.
[144] Based on the interviews with the EU-level stakeholders.
[145] Confirmed by the EU-level interviews.

Table 18. Key areas, related occupations in Western Balkans and the EU, and country-specific priorities

Area	Related ESCO occupations	Country-specific priorities
Organic food production and processing	agricultural scientist (2132.1) agronomist (2132.2) agricultural engineer (2144.1.2) veterinary technician (3240.2) agricultural technician (3142.1) farm manager (6130.1) crop production manager (6114.1) agronomic crop production team leaders (6111.1) vineyard machinery operator (6112.5) horticulture production manager (6113.2) land-based machinery operator (8341.2) crop production worker (9213.1) horticulture worker (9214.2) food technologist (2145.1.4) food safety specialist (2263.2) food safety specialist (2263.2) food biotechnologist (2131.5) food analyst (3111.3)	**Albania**: great potential for organic production is mentioned for the Healthy Food sub-sector (a proposed sub-sector within the Agriculture, Fisheries, and Aquaculture priority domain)[146] **Kosovo**: not mentioned in smart specialisation documents[147] **Montenegro:** Sustainable Agriculture and Food Value Chain is a priority area for smart specialisation. Strengthening the value chain of organic production is one of the sectoral goals[148] **North Macedonia:** organic products are mentioned as an important branch within the Food Processing with High Added Value sub-area within Smart Agriculture and Food Processing with High Added Value priority domain for smart specialisation[149] **Serbia**: organic products are mentioned as value-added products within the Food for the Future priority area for smart specialisation, with an emphasis on shifting from certified primary agricultural products to processed organic products[150]

[146] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[147] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[148] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[149] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[150] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Area	Related ESCO occupations	Country-specific priorities
Environmental science	ecologist (2133.5) environmental expert (2143.2)	**Albania**: environmental science is identified as one of the fields with high scientific potential in the country[151] **Kosovo**: environmental science is identified as one of the fields with a high share of scientific publications[152] **Montenegro:** environmental protection is identified as a new specialisation field in scientific research. Energy and sustainable environment is one of the smart specialisation priority domains[153] **North Macedonia:** environmental protection is only mentioned in relation to Energy for the Future priority area, which focuses on the energy sector[154] **Serbia**: Sustainable Food Production Chain is one of the priorities within the Food for Future priority domain. Apart from increasing efficiency and managing waste, it includes the protection of soil fertility for future production, including reduction in the use of mineral fertilisers and pesticides, use of biological and organic fertilisers, application of biological pest control measures, use of biostimulators, crop rotation, avoidance of monoculture, and the like[155]

Note: No smart specialisation publications that outline country priorities were available for Bosnia and Herzegovina

[151] Fabbri, E., Gerussi, E., Hollanders H., Sinjari, I. (2022). The identification of Smart Specialisation priority domains in Albania: A mapping exercise. Publications Office of the European Union. Available here.
[152] Hollanders, H. and Rexhëbeqaj, V. (2023). The identification of priority domains in Kosovo. A mapping exercise, Gerussi, E. editor(s), Publications Office of the European Union. Available here.
[153] Montenegro Ministry of Science (2019). Smart Specialisation Strategy of Montenegro 2019-2024. Available here.
[154] Radovanovic, N., Lazarov, D., Arizankovska, J., Majstoroska, J. and Bole, D. (2022). Qualitative analysis of economic, innovation and scientific potential in North Macedonia. Publications Office of the European Union. Available here.
[155] Ministry of Education, Science and Technological Development, Republic of Serbia (n.d.). Smart Specialisation Strategy of the Republic of Serbia 2020 – 202. Available here.

Business development occupations and skills

Among business support skills, the interviewed companies in the Western Balkans mentioned **business and project management skills, internationalisation** and **project management** as essential for their operations. This includes skills in budgeting, managing finances and preparing business plans. **Marketing and sales** occupational profiles are in high demand as well, as organic producers require specific knowledge to successfully sell their produce to consumers, specific markets, and restaurants. Such skills include understanding how to price and package organic products, and how to effectively market them. The interviewed stakeholders including companies and business intermediary bodies also expressed and expectation that the demand for these skill profiles will only grow in the future.

Many interviewed companies in the Western Balkan region also noted a deficit of **cross-cutting skills** among their current employees, especially in terms of business and economics, sales and presentation skills, and project management, which are not systematically included in secondary and tertiary education at this moment. While these skills were frequently named by the Western Balkan interviewees as a part of the necessary skillsets for farmers and other occupations related to organic food production and processing, it can be expected that as companies grow, more of these skill needs will have to be met by hiring employees who would specifically focus on business development, project management, marketing, sales, and expansion to foreign markets.

Furthermore, teamwork, general communication skills and knowledge of English language was highlighted by businesses in the niche as increasingly important transversal skills across various occupations. These findings are in line with previous research, which also found that the labour force in the Western Balkan agri-food sector lacks digital literacy, communication skills, ability to learn on the job, innovativeness and risk-taking.[156]

The skills in demand related to business development tasks, was linked to ESCO occupational profiles, provided in the box below.[157]

Box 10. Business support occupations relevant for organic food production and processing based on companies' skills needs

Internationalisation	
• import export manager (ESCO 1324.3.2)	• import export specialist (3331.2.1)
Marketing	
• marketing manager (1221.3.2) • digital marketing manager (1221.5)	• advertising specialist (2431.3) • marketing consultant (2431.10) • market research analyst (2431.11)
Business, project and financial management	
• business manager (1213.5) • project manager (1219.6)	• financial manager (1211.1)

As these occupations belong to the higher-skilled ISCO occupational groups,[158] including managers (ISCO group 1), professionals (group 2), and technicians and associate professionals (group 3), such employees generally need to be educated at ISCED level 5 or higher.[159]

[156] Radovanovic, N., Gerussi, E., Nikolic, A., & Banse, M. (2022). Smart Specialisation in the Western Balkans–the first thematic workshop on agri-food. Available here.
[157] Information on other essential skills for these occupations based on the ESCO classification of Skills, Competences and Occupations is presented in Annex 3. ESCO occupational profiles and skills.
[158] We define high-skilled occupations as ISCO occupational groups 1, 2, and 3. Lower-skilled occupations refer to ISCO occupational groups 4, 5, 6, 7, 8 and 9.
[159] Following the ILO mapping of ISCO-08 major groups to skill levels and mapping of skill levels to ISCED-97 levels of education. Available here.

In the EU, similar skills feature in employers' requirements. An important trend notable both in the EU and Western Balkan economies was that agri-food companies are becoming increasingly diverse in terms of employee occupational profiles, bringing together people with backgrounds in ICT, social sciences, life sciences, and others. This was both highlighted by the EU interviewees and demonstrated by the employment profiles of the interviewed companies in the Western Balkans.

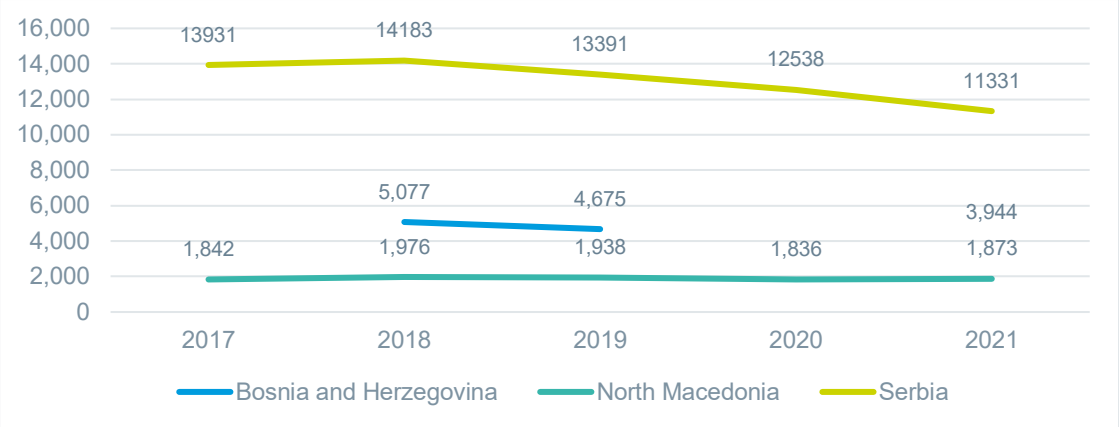
Skill supply

The interviewed stakeholders identified current skill offers provided by both tertiary education and VET as highly relevant for the companies producing and processing organic foods. Nevertheless, VET and university level education are mainly provided by education and training institutions that focus their programmes on the broader field of agriculture and food processing rather than organic food specifically. At the same time, the non-formal and informal training offer on organic agriculture is considerable in most Western Balkan economies, and potentially helps fill some of these gaps.

Initial vocational education and training

Generally, the companies engaged in the production and processing of organic foods rely on the occupations skills which are typically provided at a VET level, such as for farmers, agricultural and veterinary technicians, food and laboratory technicians, and the like. This makes VET highly relevant for providing skills for the niche, even though there is a notable decline in students' interest (see the figure below) in agricultural education and the number of agricultural education and training providers in most Western Balkan economies).

*Figure 20. The number of students in upper secondary vocational education in the fields of agriculture, forestry and fisheries (BiH, MK) and agriculture, manufacturing and food processing (RS)**



*Note: due to data availability issues, for Bosnia and Herzegovina and North Macedonia, data is presented for "Agriculture, forestry, fisheries and veterinary" in the educational field. For Serbia, data for "Agriculture, Manufacturing and Food Processing" is used.

Source: For Bosnia and Herzegovina and North Macedonia: Eurostat (2023). Pupils enrolled in vocational upper secondary and post-secondary non-tertiary education by education level, sex and field of education. Available here. For Serbia: Statistical Office of the Republic of Serbia. Available here.

The relevant VET programmes preparing people for working in the organic foods' niche are present in all Western Balkan countries. The detailed list of them is provided in Annex 4. Examples of relevant programmes that are offered in VET institutions in the Western Balkan region include programmes on agricultural machinery, agro-business, animal production, crop production, fruit and wine production, milk processing, and veterinary, and VET programmes that prepare specialists such as agricultural and veterinary technicians, farmers, food technicians, and nursery workers and flower growers. Moreover, as food production and processing jobs are increasingly technical in nature, technical VET schools, which are present in the region, can help supply skills to organic food companies.

However, some important gaps in VET skill provision are noticeable. The most notable among them is the lack of a tailored offer on the organic foods production and processing, highlighted by the

interviewed business stakeholders in Albania, Kosovo and Serbia. Business representatives shared that while educational institutions provide basic knowledge needed to work in companies, they also indicated that the lack of specific skills in organic foods is problematic – despite some relevant developments in the recent years (see the box below).

Box 11. Focus on organic food production in VET

- In North Macedonia, organic production is offered as an optional subject in two VET profiles within the qualification standards approved: Technician in phytomedicine (the subject Technology of organic production is optional) and Agrotechnician (the subject Organic production is optional).
- In Serbia, the school curriculum for organic agricultural production was developed in 2010, and was introduced into agriculture high schools starting from 2012/2013 as an optional subject (organic vegetable and crop production, organic fruit production and organic livestock production) as part of the school curriculum for Agricultural technicians.
- In Bosnia and Herzegovina, the Agency for Preschool, Primary and Secondary Education of Bosnia and Herzegovina in partnership with Enhancements in the Quality of Education and Training in South-eastern Europe (EQET SEE) project, developed the occupational standard of Agrotechnician of organic and traditional production. The development of the relevant qualification standard is still ongoing.[160]

As another major issue with VET education, the lack of **practical learning** has been mentioned by stakeholders in Albania and Bosnia and Herzegovina. Nevertheless, steps are being taken to address this issue. To illustrate, in Albania, 33-55% of VET curricula relates to practical training hours. Schools are flexible in delivering 50% of practical training in the school workshops or in a real working environment. Some VET providers have created private company networks where students are placed for their practical training per individual contracts and learning plans. Experiential learning has recently started in technical and professional schools, but the lack of funding and modern laboratory equipment remains a barrier. Private sector representatives are directly involved in the VET ecosystem as part of governing boards and as members of the final exam committees, which helps create closer links with the labour market needs.

Higher education

The higher education and training offer is generally sufficient for broader agriculture and food processing sectors, as shared by the interviewed business stakeholders. This was mentioned by interviewees and is evidenced by the fact that there are various agri-food programmes across the region, that can supply the students with general skills for the niche, with a focus on agriculture, livestock, veterinary medicine, and agrarian economy (see Annex 4. Education and training programmes at VET and university levels for a detailed list).

Overall, while agriculture is well represented in higher education programmes in the Western Balkan economies, stakeholders noted a need for more targeted programmes in food processing, as well as organic production foods. There are several higher education programmes devoted specifically to organic production in the region (see the box below), however they are not present across all Western Balkan economies.

Box 12. University programmes with focus on organic foods

- Among the Western Balkan countries, Serbia is the most advanced in terms of the provision of skills tailored for the organic foods niche, with a number of specialised higher education programmes devoted to organic agriculture. The first bachelor programme 'Organic Agriculture' in the country was launched in 2010 at the University of Novi Sad. Students are offered a variety of relevant subjects, including agricultural machinery in organic farming and organic certifications. There are also accredited master's degrees in Organic Agriculture at the Faculty of Agriculture, University of Belgrade, Faculty of Agriculture, University of Novi Sad, as well as Faculty for Biofarming in Bačka Topola, Megatrend University and Faculty of Ecological Agriculture in Sremska Kamenica, Educons University. At Megatrend University,

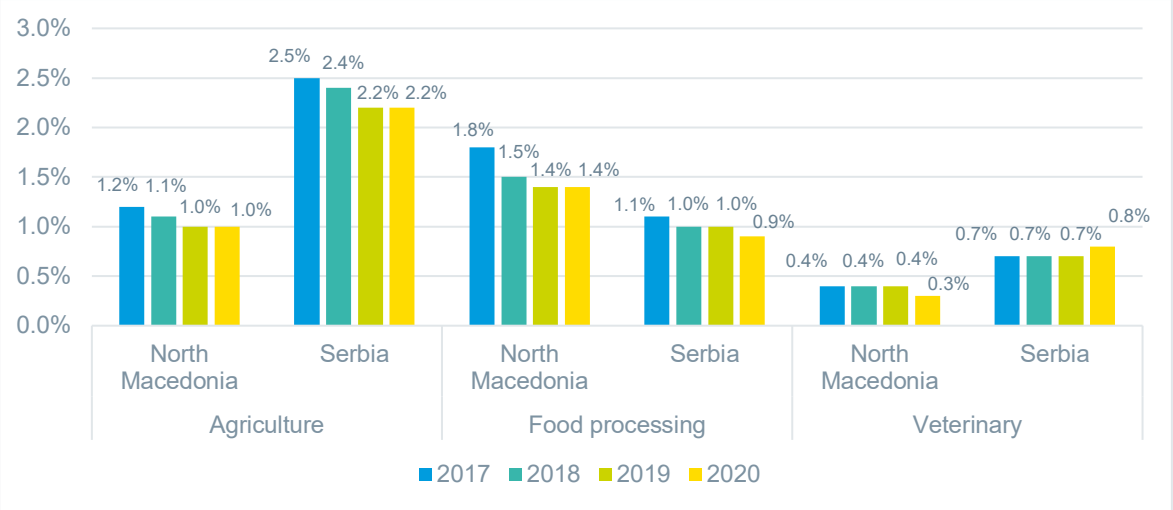
[160] More information is available here.

relevant courses include, for instance, Plant Breeding and Seed Production in Organic Agriculture and Production and Processing of Ecological Food on the Bachelor programme and Plant protection in Organic Agriculture on the Master's programme.

- In North Macedonia, University of Ss Cyril and Methodious-Skopje has a module "Eco-agriculture" within the Faculty of Agriculture. However, its enrolment rates are negligible. According to the statistical bulletin issues by the university, only three students enrolled on the module during the academic year of 2021/2022, out of a total of 76 enrolled at the Faculty of Agriculture.
- In other Western Balkan countries, no such programmes were identified.

Overall, the available data demonstrates that the share of students in university programmes in food processing and agriculture has been decreasing in North Macedonia and Serbia, although the change is not that large (see Figure 21). At the same time, the shares of veterinary sciences students remain relatively stable in both countries.

Figure 21. The share of students enrolled in tertiary programmes in food processing, agriculture, and veterinary medicine



Source: shares calculated based on Eurostat [EDUC_UOE_ENRT03]

The aggregated national statistics on the number of students enrolled in university education in fields related to agriculture, forestry and fisheries demonstrate a shrinking share of enrolled students in these study fields in Albania and Serbia in the past few years (see Table 19).

Table 19. The share of students enrolled in the field of agriculture, forestry and fisheries

Country/Year	*2018*	*2019*	*2020*	*2021*
Albania	3.6%	3.2%	2.8%	2.2%
Serbia	3.3%	3.2%	2.9%	2.9%

Source: statistic offices of Albania, Kosovo and Serbia.

In fact, some stakeholders considered the enrolment on agricultural study programmes to be alarmingly low, and this trend is common across the region. To illustrate, in 2022/2023 school year in Bosnia and Herzegovina, while the established enrolment quotas were set at a total of 477 students in the first year of agricultural studies, the actual enrolment amounted to slightly more than 13%, which means that only 66 candidates enrolled. Such small enrolment numbers show that the interest in the field is weak and there will be a serious short supply of agricultural specialists in the area of organic farming in the near future.

On-the-job learning in companies

Generally, the interviewed representatives of companies that produce and process organic foods indicated that on-the-job learning and training of new employees is an important element in filling in the gaps left by formal education and meeting the company skill needs. To illustrate, in Serbia, an interviewed company noted that on-the-job training of new employees helps them to upskill VET graduates in organic food production specific knowledge. In Albania, some of the interviewed organic food companies shared that they provide in-company training, usually independently. The training programmes provided by the interviewed companies are short-term and are mainly related to developing technical skills for using machines and equipment.

Non-formal and informal training offer

The non-formal and informal training offer in the Western Balkans that focuses on organic foods specifically is rather limited. Most of the available training offer, and knowledge acquired which is applicable in the organic food niche, takes a broader scope on agriculture, food safety and food technology (see the table below).

Table 20. Non-formal training in key areas

Area	Identified non-formal/ informal training offer
Organic agriculture	▪ **Albania**: training by the Italian Agency for Development Cooperation (COSV) partnered with the EU-funded TOKA-JONË project (organic agriculture) ▪ **BiH**: training by USAID (organic certification process) ▪ **Kosovo**: workshops by PePeKo (organic products) ▪ **North Macedonia:** training by Adult Education Centre (AEC) (organic agriculture), training by IME (organic certification) ▪ **Serbia**: training by several organisations: Terra's association; Open University; Centre for organic production; Vojvodina Organic Agriculture Cluster; Association Vitas; Association Lužničke rukotvorine; Luka znanja; National Association Serbia Organica and the National Alliance for Local Economic Development (NALED) (organic agriculture), organic internship programme by Serbia Organica
Business development for agri-food producers and processors	▪ **BiH:** training by IFAD (managerial and negotiation skills, leadership, and fundraising for poor smallholder farmers), training by INTERA (business development skills for young entrepreneurs in agriculture) ▪ **Kosovo:** training by PePeKo (access to finances, business development, scaling-up, export regulation, and access to market for organic producers), training by the Economic Chamber of Women in Kosovo (G7) with Japan International Cooperation Agency (JICA) (branding, product development and marketing for local agricultural products) ▪ **North Macedonia:** training by Winery Kamnik (wine promotion activities) ▪ **Montenegro:** information sessions by the Agricultural Cluster of Montenegro (IPARD funds)
Agriculture, agronomy and veterinary science	▪ **Albania**: training by FAO (food safety, good practices in agriculture and integrated pest management) and SME Albania (sustainable agri-food production) ▪ **BiH**: training by FAO (GLOBALG.A.P. standards for potato and plum production), training by ILO and EU (cultivating and processing medicinal and aromatic plants (MAPs)) ▪ **Kosovo**: training by the Initiative for Agricultural Development in Kosovo (IADK) (agri-food), internship programme by IADK (agriculture and food technology), workshops by PePeKo (diseases and pests and irrigation practices)

	▪ **Montenegro**: training by the Agricultural Cluster of Montenegro (food safety standards), training by the Chamber of Commerce Montenegro (agriculture and agri-food production) ▪ **North Macedonia**: training by the National Farmers Federation (agrotechnical measures and irrigation of wheat), training by Winery Kamnik (agro-technical measures for production of quality grapes, and organoleptic characteristics of wine) ▪ **Serbia**: training at the Zabela penitentiary within the EU-funded Adult Education project (agriculture)
Food technology	▪ **Albania**: training by FAO (food safety) ▪ **BiH**: training by ILO and EU (cultivating and processing medicinal and aromatic plants (MAPs)) ▪ **Kosovo**: training by PePeKo (food safety standards), internship programme by Initiative for Agricultural Development in Kosovo (IADK) (agriculture and food technology) ▪ **Montenegro**: training by the Agency for Food Safety (food safety, including HACCP, Good Agricultural Practices, Good Manufacturing Practices in agri-food, and food allergen management), roundtables by the Innovation Fund (food technology and food safety) ▪ **North Macedonia**: training by Makprogress company and the European Bank for Reconstruction and Development (EBRD) (occupational safety and handling of confectionery machinery for new employees) ▪ **Serbia**: training at the Zabela penitentiary within the EU-funded Adult Education project (food technology)

While some non-formal and informal training have been available in all Western Balkan economies, recurring and more extensive training programmes related to the organic food production were identified only in Serbia and North Macedonia. In Serbia, the relevant adult learning offer is aimed at farmers and potential organic farmers, as well as unemployed women, young people, and consumers. For example, Serbia Organica provides an organic internship programme designed for undergraduates finishing bachelor or master's studies, and / or for graduates. The organisation has also been involved in the education of staff of different institutions: professors of secondary agricultural schools, educators of the pre-school institutions, advisors of the agricultural extension, and certification bodies. Furthermore, organic certification bodies also offer education to the companies that undergo the organic certification processes. These courses are continuous. In addition to this, some of the local municipalities such as the cities of Belgrade and Novi Sad organise education for potential organic farmers and organic producers.

In North Macedonia, the process of training and knowledge dissemination in organic production is done mainly through non-formal educational courses offered by the associations in organic producers, and to some extent by the Adult Education Centre (AEC) programmes. In the database of AEC, there are six programmes related to training in organic production (see Box 13). Meanwhile, the IME is a multiannual donor supported programme funded by the Swiss government. One of its targets is the support, education, and certification of agricultural producers in organic production. At the time of data collection, the IME programme was involved in the training several producers of organic food to make their way to the Swiss market by obtaining Bio Suisse organic certification and integrating their products in Swiss supply chains.

Box 13. Example of a CVET programme in AEC in North Macedonia

The Adult Education Centre offers a programme for obtaining the qualification of 'Producer of Organic Vegetables and Fruits' provided by the Goce Delčev University of Štip. Modules on the programme include the principles and standards of organic production, the production of organic vegetables, and the production of organic fruit. This programme has a strong practical element, as more than half of the study time is spent in field. Another course at the PI Adult Education Center is the course on 'Organic Production Farmer' provided by the Foundation Agro-Center for Education. The programme consists of mandatory modules on

the principles of organic production; standards, conversion and certification; marketing of organic products; business planning; legislation, finance and subsidies; as well as practice on the farm.

A small share of identified non-formal and informal training provision for organic food SMEs also focuses on the areas related to business development of organic food businesses specifically. The interviewed companies indicated that more support for business development and internationalisation, including in terms of skills and knowledge, is desirable.

Challenges in skills matching

Organic food production and processing is present in all six Western Balkan economies, although the scale of these activities differs. Serbia, Montenegro and North Macedonia lead in terms of organic agricultural land and the number of organic food companies, these activities are still only emerging in Kosovo, Bosnia and Herzegovina and Albania. Nevertheless, stakeholders from all six economies had rather similar views towards the skill needs and challenges of skill matching.

Table 21. Challenges in skill matching in the organic foods niche

	Level of niche development	Main issues in skill matching
Organic foods production and processing		
AL	The niche remains small although rapidly growing in terms of certified organic foods companies and production volumes.	Difficulties in hiring qualified agricultural workforce, arising from decreasing enrolment in agriculture and food production related programmes, a lack of focus on organic production in education and training programmes at VET and university education levels
BA	The niche remains small although rapidly growing in terms of certified organic foods companies and production volumes.	VET and university graduates in the relevant fields lack practical skills applicable in companies. This is related to the lack of internship opportunities and the lack of on-the-job training as part of the training programmes.
XK	The niche is very small in terms of production volumes and operating companies.	VET and tertiary education programmes provide only very general skills in agriculture and food processing, no specific courses on organic food production are available.
ME	A notable and increasing number of organic producers operate in the country, large area of organic agricultural land.	The relevant skills are provided through education and training programmes at VET and university levels, however, no specific programmes on organic food production are available.
MK	Largest number of organic producers in the region, low number of organic processors.	Insufficient focus on practical skills working with modern technology and on transversal skills in university and VET level education. Low interest and enrolment in organic production university programmes and VET courses.
RS	Large number of organic producers, and largest area of organic agricultural land and number of organic processors in the region.	Education related to organic food production is well represented in the educational system at all levels. Absence of university and VET programmes which can offer the right mix of domain skills, and some general skills such as marketing or soft skills in general.

The unsatisfied skill demand concerns both high-skilled and low-skilled occupations in the relevant fields (i.e. form elementary works, farmers to agricultural scientists and food biotechnologists). The skill gaps, in most Western Balkan economies, affect field-specific knowledge related to organic farming and food processing, and knowledge of organic standards, and labelling and certification processes. Meanwhile, the technological advances in agri-food lead to an increasing need for workers to acquire at least user-level digital skills; and the policy direction of the green economy increases the relevance of knowledge related to sustainable production, carbon footprints, and animal welfare which are difficult for companies to secure.

The skill supply does not sufficiently address these gaps, even though the supply of study programmes at VET and tertiary levels in the broad fields of agriculture and food processing has been

assessed by interviewed stakeholders as sufficient. First, the formal education and training focusing specifically on the organic food production and processing processes specifically remains scarce, while the overall interest of students in agricultural education at all levels is in decline. Second, the interviewed stakeholders repeatedly noted that the level of knowledge and practical skills of graduates are not sufficient and are too theoretical. New graduates also lack the skills to use modern technology, for communication and teamwork skills, and lack an adequate knowledge of English. Third, the lack of multidisciplinary approach to education and absence of courses related to marketing, communication skills and similar is obstructing the further development of the companies in this niche and their market expansion both domestically and internationally.

Conclusions

The report provided an overview of the agri-food sector development in the Western Balkans, with a particular focus on three developing market niches: digitalisation in agri-food, biochemical and microbial products for agri-food, and organic and functional food production. The three niches represent different links in the agri-food value chains, from the production of agricultural inputs to food production and processing. However, they had not been conceptualised before, and were used as separate categories in this specific research project for the same time. This presented some challenges for the study, specifically linked to the access of statistical data. While statistical systems in some of the Western Balkans are generally underdeveloped, with a lot of information lacking, focus on such specific sub-segments faced additional gaps in knowledge. Nevertheless, combination of the available statistics and qualitative data applied in a comparative manner allowed to make a number insights into these three narrow areas of economic activities and their skills needs in the Western Balkan region.

While all the three market niches are considerably more developed in the EU than the Western Balkan region, they represent sub-sectors of economic activity to which several opportunities for Western Balkans could be linked. This is especially true in the context of Smart Specialisation. Agri-food production has been identified as one of the common priority areas for economic growth in the Western Balkans. The rapid development of the ICT sector linked to the digitalisation solutions for agri-food, as well as the biochemistry sector linked to the biochemical and microbial products, further indicates untapped potential for innovation in the agri-food value chains in the region. In addition to this, innovative products for agri-food have the potential to provide export and internationalisation opportunities.

Nevertheless, the report also indicated a list of challenges that need to be addressed first. Many of them are linked to the main focus of this study: the skills demand by the companies that innovate and develop their businesses and the training provision that is available within the three market niches analysed in the study.

The structural challenges include, most notably, at the early stage of development of the market niches and the ecosystems of stakeholders, regulation and funding around them. As this goes hand in hand with the small scale of production, it also results in barriers to raising international competitiveness. Most companies operating in these economic activity areas produce small quantities of products, and therefore have difficulties placing them on the international markets that require consistent delivery of products in appropriate quantities with reliable quality. At the same time, domestic demand for the products of some of the niches is low or barely existent. In some cases (e.g., organic foods) this relates to consumer awareness; in others (e.g., digitalisation in agricultural holdings) the lack of demand is a result of the farm size, structure, gap in rural-urban digitalisation and resources.

The Western Balkan region is also heterogenous in this regard. While Serbia has considerably the most advanced level of development in the three market niches, in some other Western Balkan economies, such as Albania and Bosnia and Herzegovina, few or no companies exist that engage in the development and production of digital solutions for agri-food, or biochemical and microbial fertilisers and PPPs. The summary by country is provided in the table below.

Difficulties in recruiting personnel with skills needed for the development of the three areas of economic activities was reported by many interviewed companies as another major obstacle. In many cases, educational curricula are outdated or too general to provide practical skills to be immediately applicable in the companies of the three niches. The programmes do not include skills of working with modern equipment and methodologies. Except for the organic production activities, specialised education and training programmes addressing the specific combinations of technical skills required for the analysed market niches (e.g., specialist IT skills and knowledge of agriculture) are scarce. Furthermore, soft and transversal skills, especially in languages, communication, sales and marketing are not sufficiently available in the market as well. Attracting personnel with skills necessary for

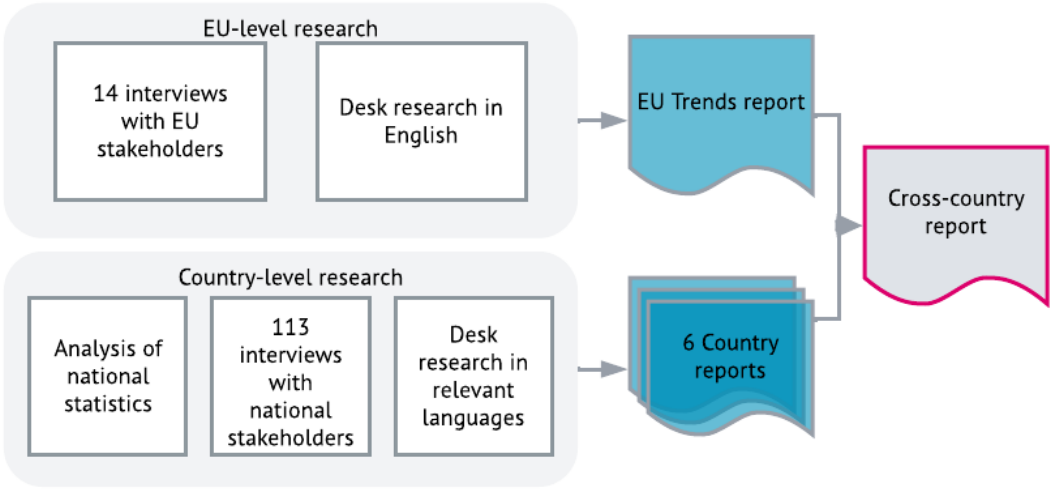
commercialisation, internationalisation and business development more broadly is especially difficult in the areas of economic activities in which the pay is not considerably high (i.e., biochemical and microbial, as well as organic foods production). Many companies turn to in-house trainings and job-based learning to meet their skills needs, or higher external consultants to meet some of the specific expertise needs.

Stakeholders also noted that there is a large untapped potential to further strengthen all, formal, non-formal and informal education and training through increased cooperation between companies, education providers and intermediary bodies. At least one of the results of such cooperation could be structurally supported by internship opportunities (e.g., dual VET systems are either non-existent or in the early stages of implementation) which are currently lacking. Considering the technological and markets trends identified in the three niches in the EU as a path that the Western Balkan economies are likely to follow, the action to support meeting the skills demand is going to become increasingly crucial.

Annex 1. Methodology

The analysis presented in this report is based on the analysis of available statistical data, desk research and 127 interviews. The Cross-country report presents a synthesis of several streams of data collection and analysis at EU and country levels in the Western Balkans. The graph below illustrates the overall study design. The following sections, meanwhile, explain the main details on data collection, definition of study scope, and limitations of the research design.

Figure 22. Study design



Data collection

This cross-country report is prepared on the basis of the six country reports developed in Albania, Bosnia and Herzegovina, Kosovo, Montenegro, North Macedonia, and Serbia, as well as additional research of the EU level developments.

The country reports were prepared by the national experts based in the Western Balkan economies. The data was collected following a two-step process. In the first step, national experts conducted **desk research** on the agri-food sector and descriptive **statistical analysis** of the available data from national statistics sources and Eurostat. If certain statistical information was not available online, the national experts contacted the national statistics offices and public employment services to request additional data.

Desk research was conducted using academic and grey literature, policy documents, papers developed by international organisations, company websites, job search portals, education programmes (especially initial VET and CVET) and syllabuses, as well as online publications.

Desk research was done in the following steps:

1. **Defining search keywords** and search strings, as well as translating them into the national languages (see Table 22 for search keywords).
2. **Search**, using universal search engines (e.g. Google, Google Scholar, Goole Dataset Search), scientific literature databases and publication depositories of relevant organisations, projects and initiatives (e.g. ETF, European Commission, Regional Cooperation Council, ILO and World Bank, national authorities).
3. **Refinement of the search results** based on their relevance and quality. Various relevant sources were eligible for analysis, including policy documents, media messages, press

releases, company and other websites, academic literature, as well as reports by researchers and practitioners.

4. **Synthesis of relevant findings**. The synthesis focused on covering the research questions and filling in the data collection templates, that then fed into the country reports.

Table 22. Example of search keywords used in desk research

Topic	Keywords
Agri-food	Agri-food, agrifood, agrofood, agro-food, food production, food manufacturing, food distribution, food processing, agriculture, agribusiness, farming, crop production, livestock production, horticulture
Organic/functional food	Organic, fortified food, functional food, nutraceuticals, medicinal herbs, food supplements
Microbial/biochemical products for agriculture	Biofertilisers, bio-fertilisers, biopesticides, microbial products, crop probiotics, animal probiotics, biostimulants, biocontrols, biofungicides, organic fertilisers, micro-organisms, fungi, algae, bacteria
Digitalisation in agri-food	Digitalisation, new technologies, traceability, precision farming, digital, automation, robotics, virtual, IoT, I-IoT drones, modelling, simulation, Agriculture 4.0, smart farming, big data, AI, machine learning, deep learning, AR, VR, photonics
Skills, VET and CVET	VET, CVET, IVET, vocational education and training, continuing vocational education and training, skills demand, skills need, skills supply, skills matching, skills mispatch, knowledge provider, knowledge broker, qualification, training, education, non-formal education, career guidance and career education, in-company training
Intermediary bodies	Intermediary body, association, chamber of commerce, council, industry, hub

In the second phase of the data collection process, the national experts carried out interviews with representatives of four types of stakeholders: businesses, the public sector, education and training providers, and business intermediary bodies (such as employers' organisations, trade unions, chambers of commerce, and NGOs). In total, **113 national interviews** were conducted in the six Western Balkan economies.

The interviews were **semi-structured**. All national experts followed the standardised interview questionnaires prepared by PPMI and ETF for each type of stakeholder (business, public sector, education and training providers, and business intermediary bodies), but were free to adjust them for a particular interviewee.

Additionally, the PPMI team conducted research on technological trends and skills needs in the three agri-food niches in the EU. The report draws on the findings from desk research and **14 interviews** with representatives of EU-based business associations, research institutes and centres, digital innovation hubs, businesses, and individual academic researchers.

The full list of all interviewees is presented in at the end of this Annex.

Definition of the market niches and selection of companies

To analyse the technological changes in the agri-food sector, the study focuses on three market niches identified by the ETF: digitalisation in agriculture and food processing, biochemical and microbial products for agri-food, and production of organic/functional foods.[8]

The niche definition and selection were based on the Call for participation launched by the ETF, targeting SMEs looking to build up skills for digital and sustainable transition in the agri-food sector. In total, 19 enterprises were selected through the initial call. The analysis of their activities and markets allowed to assign them to the three niches, defined for the purposes of this assignment. While they are not reflected in the traditional classifications of economic activities (i.e., NACE), the research team has mapped the broader sectors under which the activities implemented by these companies fall (they are referenced throughout the report). On that basis, additional companies, that became participants in the interview programme, were identified based on the following criteria.

- **Innovativeness.** The following aspects were considered:

- Investment into research and development (and/or)
- Investment into business innovation (of existing products, services or processes) (and/or)
- Company is the owner or licensee of a registered patent.

- **Western Balkan origin,** rather than a branch of a foreign company.
- A company is focused on the **agri-food value chain**, rather than other related activities not related to food production and distribution.

Limitations of the research design

Several important limitations should be considered regarding the generalisation of the findings of this exploratory study.

The first limitation is related to how the three niches are defined. They had not been used as separate categories prior to the study. This presented some challenges, specifically linked to the access of statistical data. While statistical systems in the Western Balkans are generally underdeveloped, with a lot of information lacking, focus on such specific sub-segments of economic activities meant additional gaps in available data.

Therefore, most insights were made relying on a combination of incomplete statistical data and a convenience sample of companies meeting the selection criteria.

On the one hand, it is important to note that the NACE codes that were used in statistical analysis are much broader than each market niche of interest in this study. Therefore, the available statistical information should be understood as providing the context in which the companies that were assigned to specific niche in this study operate.

On the other hand, the insights coming from the selected companies identified by the ETF of the country experts cannot be understood as representative of the entire niches. The insights stemming from the interviews should be understood as the initial step of defining and researching this type of economic activities and related challenges in the region. The precise size of each niche in the Western Balkan economies was not possible to determine using the methods applied in this study, and the opinions of the representatives of the selected companies might not be entirely representative of all similar companies operating in the Western Balkan economies.

Therefore, the study results presented in the report should be understood as exploratory. An in-depth study into each niche in every Western Balkan economy is necessary to further define and analyse these emerging economic activities in the agri-food value chains.

The list of interviewees

Table 23. The list of interviewees

Number	*Country*	*Stakeholder type*	*Organisation*	*Date of the interview*
1	Albania	Business	ABA Online	30.11.2022
2	Albania	Business	Misfruit	30.11.2022
3	Albania	Business	Agrimatco	06.12.2022
4	Albania	Business	Agroinput Jazxhi	13.12.2022
5	Albania	Business	Planta.shpk	29.11.2022
6	Albania	Business	Alb Calystan	05.12.2022
7	Albania	Business	Alb-tech	
8	Albania	Business	Hojeza	22.11.2022
9	Albania	Business	MUSAJ OLIVE OIL SHPK	02.12.2022
10	Albania	Business intermediary	SME Albania	02.12.2022

11	Albania	Business intermediary	Albanian Agribusiness Council (AAC)	05.12.2022
12	Albania	Business intermediary	CCIT Tirana	08.12.2022
13	Albania	Public sector	Ministry of Agriculture and Rural Development	10.12.2022
14	Albania	Public sector	National Agency for Scientific Research and Innovation (NASRI)	06.12.2022
15	Albania	Public sector	Regional Agricultural Extension Agency Korcë	06.12.2022
16	Albania	Education and training provider	Agricultural University of Tirana	24.11.2022
17	Albania	Education and training provider	Research and Teach. Group, Business Informatics (Faculty of Economy and Agribusiness)	06.12.2022
18	Albania	Education and training provider	Faculty of Agriculture, UNIKO	02.12.2022
19	Albania	Education and training provider	Irisoft	28.11.2022
20	Albania	Education and training provider	Institute of economic studies and knowledge transfer	21.11.2022
21	BiH	Business	Sherbetlook	05.12.2022
22	BiH	Public sector	Federal Ministry of Education and Science (FMON)	21.11.2022
23	BiH	Education and training provider	Economic Institute	21.11.2022
24	BiH	Public sector	Development Programming Institute of FBiH	23.11.2022
25	BiH	Public sector	Ministry of Foreign Trade and Economic Relations of Bosnia and Herzegovina	28.11.2022
26	BiH	Business intermediary	Chamber of Commerce of Canton Sarajevo	24.11.2022
27	BiH	Education and training provider; Business intermediary	Center for education and IT affairs of the Sarajevo Canton Chamber of Commerce	24.11.2022
28	BiH	Business intermediary	Foreign Trade Chamber of Bosnia and Herzegovina, the Association for Agriculture and Food Industry	09.12.2022
29	BiH	Education and training provider	Faculty of agriculture and food sciences, University of Sarajevo	01.12.2022
30	BiH	Business	Šumska tajna	28.11.2022
31	BiH	Business intermediary	INTERA Technology Park, Mostar	10.12.2022
32	BiH	Business intermediary	Innovation Center Banja Luka, ICBL	10.12.2022
33	BiH	Business	Bionatura doo, Vareš	12.12.2022
34	BiH	Business	Greens doo, Hotonj	09.12.2022
35	BiH	Business	PZ Smart Village, Kozarska Dubica	09.12.2022
36	Kosovo	Business	ZemraFarm	21.11.2022
37	Kosovo	Business	FARA	23.11.2022
38	Kosovo	Business	SanteFruit	25.11.2022
39	Kosovo	Business	Eco Solution Research	25.11.2022
40	Kosovo		Biotech Agriculture	06.12.2022
41	Kosovo	Business	GoBeyond	07.12.2022
42	Kosovo	Education and training provider	University of Pristina	09.12.2022
43	Kosovo	Business intermediary	Association of Fruits and Vegetable Processors (PePeKo)	12.12.2022
44	Kosovo	Business intermediary	Kosovo Investment and Enterprise Support Agency (KIESA)	15.12.2022
45	Kosovo	Education and training provider	Vocational Training Center (VCT) in Pristina	16.12.2022
46	Kosovo		Initiative for Agricultural Development of Kosovo (IADK)	16.12.2022

47	Kosovo	Education and training provider	High School of Agriculture in Pristina	19.12.2022
48	Kosovo	Public sector	Ministry of Agriculture, Forestry and Rural Development	22.12.2022
49	Kosovo		Agrocelina	23.12.2022
50	Kosovo	Business intermediary	Employment Agency of Kosovo	29.12.2022
51	Kosovo	Public sector	Ministry of Education, Science, Technology and Innovation of Kosovo	06.01.2023
52	Montenegro	Business	Seljak.me	30.11.2022
53	Montenegro	Business	Honey SWAT	12.12.2022
54	Montenegro	Business	Montenegro company, Fish feed project (start-up)	13.12.2022
55	Montenegro	Business	Academy for Urban Ecological Engineering	02.11.2022
56	Montenegro	Business	Dairy Farm Miljanic	02.11.2022
57	Montenegro	Business	Tuko company	20.11.2022
58	Montenegro	Business	Radovic agri-pharmacy	24.11.2022
59	Montenegro	Business intermediary	Chamber of Economy of Montenegro	28.11.2022
60	Montenegro	Business intermediary	Science Technology Park of Montenegro	31.11.2022
61	Montenegro	Business intermediary	Tehnopolis	09.12.2022
62	Montenegro	Business intermediary	Innovation Fund of Montenegro	04.12.2022
63	Montenegro	Public sector	Ministry of Agriculture	02.12.2022
64	Montenegro	Public sector	Ministry of Science and Technology	05.12.2022
65	Montenegro	Education and training provider; business intermediary	Biotechnical Faculty, BIO-ICT Centre of Excellence	08.12.2022
66	Montenegro	Education and training provider	University of Donja Gorica	17.11.2022
67	Montenegro	Education and training provider	Vocational Educational Centre of Montenegro	21.12.2022
68	North Macedonia	Business	Bioengineering	22.11.2022
69	North Macedonia	Business	AgFutura Technologies	16.12.2022
70	North Macedonia	Business	Vision Dynamix	30.11.2022
71	North Macedonia	Business	Greenagro dooel	05.12.2022
72	North Macedonia	Business	Dron Ops LLC Shtip	01.12.2022
73	North Macedonia	Business	ChiaDía (Kinado)	25.11.2022
74	North Macedonia	Business	Organauts (Organic Sailors)	12.12.2022
75	North Macedonia	Business	Pro-Fit Vis	25.11.2022
76	North Macedonia	Business intermediary	Increasing Market Employability (IME)	25.11.2022
78	North Macedonia	Business intermediary	Business Confederation of Macedonia	07.12.2022
80	North Macedonia	Public sector	Fund for Innovation and Technological Development (FITR)	01.12.2022
81	North Macedonia	Business	Ferthem-Tim Veles	04.12.2022
82	North Macedonia	Business intermediary	Employment Service Agency	16.12.2022
83	North Macedonia	Education and training provider	Adult Education Center	29.11.2022
84	North Macedonia	Education and training provider	Faculty of Technology and Metallurgy, Skopje	29.11.2022
85	North Macedonia	Education and training provider	University Gotse Delchev, Faculty of Agriculture, Shtip	23.11.2022

86	North Macedonia	Business intermediary	UNDP	06.12.2022
87	North Macedonia	Education and training provider	VET school Brakja Miladinovci-Skopje	06.03.2023
88	Serbia	Business	Carnomed	28.11.2022
89	Serbia	Business	Atfield Technologies	29.11.2022
90	Serbia	Business	B-fresh Technologies	30.11.2022
91	Serbia	Business	Biofor System	01.12.2022
92	Serbia	Business	Farmbot	01.12.2022
93	Serbia	Business intermediary	IMMGE	01.12.2022
94	Serbia	Education and training provider	CATUS; Agricultural school Sremska Mitrovica	02.12.2022
95	Serbia	Business	Dunavnet	05.12.2022
96	Serbia	Business intermediary	Biosense Insitute	07.12.2022
97	Serbia	Education and training provider	Science and Technology Park Novi Sad	08.12.2022
98	Serbia	Public sector	Ministry of Education	09.12.2022
99	Serbia	Public sector	Innovation Fund	12.12.2022
100	Serbia	Business intermediary	Vojvodina ICT Cluster	13.12.2022
101	Serbia	Education and training provider	Science and Technology park Cacak	14.12.2022
102	Serbia	Business intermediary	LAG Čačak	21.12.2022
103	Serbia	Business intermediary	Agro Logistic 032	22.12.2022
104	Serbia	Business intermediary	Chamber of Commerce and Industry of Serbia	23.12.2022
105	Serbia	Business intermediary	Swiss Cooperation Office in Serbia	27.12.2022
106	Serbia	Business intermediary	Chamber of Commerce and Industry of Serbia	29.12.2022
107	Serbia	Business	Takovo Berry	30.01.2023
108	Serbia	Education and training provider	Agricultural school Vršac	02.02.2023
109	Serbia	Education and training provider	Agricultural and veterinary school Svilajnac	03.02.2023
110	Serbia	Education and training provider	Agricultural and food school Sombor	03.02.2023
111	Serbia	Business	Bacillomix CO	03.02.2023
112	Serbia	Business	Organela	06.02.2023
113	Serbia	Business	Serbia Organica	07.02.2023
114	EU	Business intermediary	Smart Farm Colab	15.12.2022
115	EU	Researcher	Katarzyna Kosior	11.01.2023
116	EU	Business intermediary	Microbial Plant Protection Products Task Force	09.12.2022
117	EU	Business intermediary	IBMA	05.12.2022
118	EU	Business intermediary	ICT-AGRI-FOOD	02.12.2022
119	EU	Business intermediary	ITC Cluster	10.01.2023
120	EU	Business intermediary	Farm Tech Society	02.12.2022
121	EU	Business intermediary	DFKI (German Centre for Artifical Intelligence)	02.12.2022
122	EU	Business intermediary	EFFoST	09.12.2022
123	EU	Research institution	Innovative Food System, Production Systems Unit, Natural Resources Institute Finland (LUKE)	15.12.2022
124	EU	Business intermediary	FEST Didactic	08.12.2022
125	EU	Business	Lackner Ventures & Consulting GmbH	06.12.2022

126	EU	Business intermediary	FiBL Europe	20.12.2022
127	EU	Business intermediary	GenerationAG	10.01.2023

Annex 2. Company profiles

Digitalisation in agri-food across the Western Balkans (Interviewed companies)

Country	Type of activities	Company	Main products/services	Export	Employment structure
Albania	**Application of digital technologies in the agri-food sector**	MisFruit	**Type of product/platform**: Marketing Information System (MIS) **Main activities**: Provide information on agricultural inputs, market price analysis and forecasts for traders and farmers, including information on foreign markets. Technical assistance on farms and promotional services, such as success stories, and maintain a database on agricultural producers.	No	**Number of employees**: 6 **Gender split**: 4 men, 2 women **Education levels**: All employees have higher education (mainly in administration and production)
		ABA Online	**Type of product/platform**: Information and services platform **Main activities**: Provide information on production technologies to farmers, facilitate networking, conduct financial and technical education, and promote success stories.	Western Balkans	**Number of employees**: 20 **Gender split**: 14 men, 6 women **Education levels**: All employees have higher education (mainly in administration, engineering and production)
Bosnia and Herzegovina		Smart Village Knežica	**Type of product/platform**: Digital Innovation Hub **Main activities**: R&D networking, Innovation Hub, ideas development, developing blockchain technology for digital food quality and traceability.	No	**Number of employees**: 20 **Gender split:** Majority men **Education levels**: All employees have higher education
Kosovo	**Development and/ or production of innovative solutions for agri-food**	FARA	**Type of product/platform**: Full-scale automation solutions for agricultural production **Main activities**: Develop automated smart farm solutions for digital control and monitoring, greenhouse automation, including automated irrigation systems.	Provided services for clients in CH and IT, but not related to digitalisation in agri-food	**Number of employees**: 8 employees **Gender split**: 7 men, 1 woman **Education levels**: 4 employees have higher education, 4 students
		BioTech Agriculture	**Type of product/platform**: Full-scale automation solutions for agricultural production **Main activities**: Automated smart farm solutions for digital control and monitoring, greenhouse automation, including automated irrigation systems.	No	**Number of employees**: 3 **Gender split**: 2 men and 1 woman. **Education levels**: All employees have higher education
Montenegro		HoneySwat	**Type of product/platform**: IoT developer **Main activities**: Develop smart water dispensers for bees.	No	**Number of employees**: 1 **Gender split**: 1 man **Education levels**: All employees have higher education

		Montenegro Company, Fish Feed project	**Type of product/platform**: IoT developer **Main activities**: Develop automatic fish feeders that are connected to IoT systems.	No	**Number of employees**:1 **Gender split**: 1 man **Education levels**: All employees have higher education
		Seljak.me	**Type of product/platform**: Digital platform for agriculture **Main activities**: E-commerce and educational information on agri-food in Montenegro.	No; they plan to expand their operations in the Western Balkans but lack resources at this time.	**Number of employees**: 4 (2 full-time, 2 part-time) **Gender split**: 2 men, 2 women **Education levels**: The owner has higher education, whereas the other full-time worker has secondary education; part-time workers are students
North Macedonia		DronOps	**Type of product/platform**: Drone developer **Main activities**: Develop commercial drones to provide services in crop spraying and seed planting, mapping and surveying, and soil and plant analysis.	No	**Number of employees**: 3 **Gender split**: 3 men **Education levels**: All employees have higher education
		AgFutura Technologies	**Type of product/platform**: Comprehensive digitalisation solutions for agri-food production **Main activities**: Wholescale digital technologies development for agri-food, with focus on IoT technologies and drones. They also offer business consulting and marketing services.	Western Balkans and internationally	**Number of employees**: 9 **Gender split**: 4 men and 4 women **Education levels**: All employees have higher education
		Vision Dynamix	**Type of product/platform**: Drone and 3D mapping technologies developer **Main activities**: Primarily focus on developing solutions for construction and mining, though they also provide services such as mapping, surveilling and visualising in agri-food.	Western Balkans and internationally	**Number of employees**: 5 **Gender split**: 5 men **Education levels**: All employees have higher education
Serbia		DunavNET	**Type of product/platform**: Artificial intelligence developer **Main activities**: Develop comprehensive solutions utilising enterprise-grade Internet of Things (IoT), Machine Learning/Artificial Intelligence (ML/AI) for both agriculture and food and beverage production.	Western Balkans, EU, UK, US	**Number of employees**: 8 **Gender split**: 4 men, 4 women **Education levels**: All employees have higher education
		Atfield Technologies	**Type of product/platform**: IoT developer **Main activities**: Develop software and IoT solutions for viticulture growing and vineyard management. They also develop battery-less weather stations.	UK, US, BA, and RO	**Number of employees**: 8 **Education levels**: one employee educated at ISCED level 8, five employees educated at ISCED level 7, and two at ISCED level 4. There is 1 undergraduate student in the team
		FarmBot doo	**Type of product/platform**: Robot developer **Main activities**: Develop multi-functional robotic systems (landscape robot) agricultural production.	Local market and CZ (limited introduction)	**Number of employees**: 4 **Gender split**: 4 men

			The robot can mow, spray, and prepare soil in challenging terrains.		**Education levels**: two employees have higher education, while two are undergraduate students

Biochemical and microbial products for agri-food across the Western Balkans (Interviewed companies)

Country	Type of activities	Company	Main products/services	Export	Employment structure
Albania	**Retail and repackaging**	Agrimatco Albania shpk.	**Main activities**: Retail and repackaging of pesticides, herbicides, and fertilisers.	No	**Number of employees**: 9 **Gender split**: 6 men, 3 women **Education levels**: 1 employee has higher education, 8 have post-secondary education (mainly in engineering, transportation, administration and machinery maintenance)
		Agroinput Jazxhi shpk.		Mainly export to the Western Balkans.	**Number of employees**: 7 **Gender split**: 4 men, 3 women **Education levels**: 6 employees have higher education (mainly profiles in administration, installation and maintenance, and agronomy), while 1 has post-secondary
		Planta shpk.		No	**Number of employees**: 6 **Gender split**: 6 men **Education levels**: 5 employees have higher education, 1 has post-secondary
Montenegro		Agro-pharmacy Radovic	**Main activities**: Retail of biochemical and microbial products, such as crop probiotics, bio-fertilisers and bio-stimulants.		**Number of employees**: 10 **Gender split**: 75% women **Education levels**: Most employees have higher education (in agricultural sciences and economics), but administrative staff have secondary
Kosovo	**Development of innovative solutions**	Eco Solution Research	**Main activities**: Development of organic fertilisers and biogas from food waste processing.	No	**Number of employees**: 5 (2 full-time and 3 part-time) + consultants on grant basis. **Gender split**: 2 Women full-time, 1 woman part-time, 2 men part-time **Education levels**: All employees have higher education
		GoBeyond	**Main activities**: Innovative insect farming to develop protein. They develop natural fertilisers from insects and protein powder.	No	**Number of employees**: 3 (2 full-time, 1 part-time) **Gender split**: 3 women **Education levels**: All employees have higher education

North Macedonia		GreenAgro	**Main activities**: Development of animal nutrition products and forage mixtures.	Western Balkans, the Middle East, CA, and AU	**Number of employees**: 11 **Gender split**: 8 men, 3 women **Education levels**: 8 employees have higher education (veterinary science and agriculture), others have secondary
		Bioengineering	**Main activities**: Development of biopesticides and enzymes for wine-making.	Region	**Number of employees**: 11 **Gender split**: 6 men, 5 women **Education levels**: All employees have higher education (mainly in genetics, biology, and other natural sciences)
		Ferthem-Tim	**Main activities**: Fertiliser production, also provide training on improving soil fertility to farmers.	No	**Number of employees**: 8 **Gender split**: 7 men, 1 woman **Education levels**: 5 employees have higher education (chemical engineers), others have secondary (agricultural technicians and economists)
Serbia		B-Fresh Technologies	**Main activities**: Development of cutting-edge packaging technologies for fresh foods. Developed a bio-polymer emulsion that prevents packed food from going bad quickly. Currently is preparing for patenting.	RU, exploring options to export to the US.	**Number of employees**: 6 **Gender split**: 4 women, 2 men **Education levels**: All employees have higher education
		Biofor System	**Main activities**: Development of bio-fertiliser, in addition to developing composting products.	RS, HR, SI and BA (mainly Western Balkans)	**Number of employees**: 29-30 **Gender split**: Mostly men, but two out of three founders are women **Education levels**: All employees have higher education
		Bacillomix	**Main activities**: Production and distribution of organic and microbiological soil fertilisers.	Western Balkans and SI	**Number of employees**: 7 **Gender split**: 5 women, 2 men **Education levels**: 6 employees have higher education (mainly agricultural engineers). They also hire seasonal production operators, who usually have secondary education

Organic foods across the Western Balkans (Interviewed companies)

Country	Company	Place in the value chain	Market niche segment	Main products/services	Export	Employment structure
Albania	Musaj Olive Oil shpk	Processing	Organic	Olive oil	Western Balkans	**Number of employees**: 8 **Gender split:** 6 men and 2 women **Education levels**: Employees have higher education

	Hojeza shpk	Production	Organic	Honey	Western Balkans	**Number of employees**: 4 **Gender split:** 2 men and 2 women **Education levels**: Employees have higher education
	Alb Calystan shpk	Production	Organic, functional	Medicinal and aromatic plants (MAPs)	US, CA, AU, IN	**Number of employees**: 60 **Gender split:** 30 men and 30 women **Education levels**: 45 employees with secondary education, 15 employees with higher education (fields of management, chemistry, production)
Bosnia and Herzegovina	Šumska tajna d.o.o	Production, processing	Organic, functional	Raspberries, strawberries, medicinal herbs, mushrooms, wild fruits	EU (DE as the main market)	**Number of employees**: 3 employees plus seasonal workers **Gender split:** The owner is a woman **Education levels**: The owner has a tertiary education; an external consultant with tertiary education. All other are seasonal workers and can be of different level of education and varies from season to season
	Sherbetlook	Production	Organic, functional	Medicinal and aromatic herbs (lavender, rose and mint), fruits and vegetables, juices, syrups, jams, ajvar[161], jam and teas	No	**Number of employees**: 3 employees plus seasonal workers **Gender split:** 1 man and 2 women **Education levels**: 2 employees with higher education, 1 with secondary
	Greens doo	Production	Organic	Microgreens, including edible flowers, tiny vegetables, and herbs	No	**Number of employees**: 3 full-time employees plus a large number of seasonal workers **Gender split:** 2 men and 1 woman **Education levels**: 2 employees with higher education, 1 with secondary
	Bionatura doo	Production, processing	Organic, functional	Cereals, medicinal and aromatic herbs, forest fruits and mushrooms	No	**Number of employees**: 5 **Education levels**: 2 employees with higher education, 1 with secondary
Kosovo	ZemraFarm	Production, processing	Organic, functional	Raspberries, vegetables and aromatic herbs, cold pressed natural juice, dried fruits and vegetables, and confectionary products	NL	**Number of employees**: 3 employees plus up to 20 seasonal workers **Gender split:** employees – 2 men and 1 woman, seasonal workers – mainly women
	SanteFruit	Production	Organic	Blueberries	NL, DE, RS, and AL	**Number of employees**: 5 employees and up to 80 seasonal workers **Gender split:** employees – 2 men and 3 women, seasonal workers – 20 men and 60 women

[161] A condiment made principally from sweet bell peppers and eggplants.

						Education levels: 4 employees with university degree (agriculture, mechanical engineering), 1 employee with secondary education
Montenegro	Academy for Urban Ecological Engineering	Production, processing	Functional	Spelt juice	No	**Number of employees**: 1 employee plus 2 part-time employed students **Gender split:** 1 woman and 2 men **Education levels**: 1 employee with university degree and 2 with secondary education
	Dairy Farm Miljanic	Production, processing	Organic	Dairy	No	**Number of employees**: 5 **Gender split:** 1 man and 4 women **Education levels**: 1 employee with higher education, the rest with secondary education
	Tuko company	Production, processing	Organic	Meat	No	**Number of employees**: 5 **Gender split:** 4 men and 1 woman **Education levels**: 40% of employees with higher education in agriculture, business and economics, the rest with secondary education
North Macedonia	ChiaDía	Processing, retail	Functional	Drink from chia seeds	No	**Number of employees**: 3 **Gender split:** All women **Education levels**: All employees have higher education in economics
	Organauts	Production, processing	Organic	Fruit and vegetable delicatesses, organic juices, vegetable pastes and sweet products from grape must	BG, IT	**Number of employees**: 2 **Gender split:** All men **Education levels**: All employees have higher education in engineering
	Pro-Fit Vis	Processing	Functional	Protein crackers Endocrinologist and nutritionist consultation services to customers	No	**Number of employees**: 3 **Gender split:** All women **Education levels**: All employees have higher education in business
Serbia	Carnomed	Processing	Functional	Nutritional supplements	Balkan region, EU, UK, USA, AU	**Number of employees**: 8 **Gender split:** 4 men and 4 women **Education levels**: All employees have higher education
	Organela	Production, processing	Organic	Service-oriented organic farming: production of primary organic products for around 30 clients from urban area (fruits, vegetables) and drinks (juices, teas)	No	**Number of employees**: 4 **Gender split:** 2 men and 2 women **Education levels**: All employees have higher education in the field of agricultural engineering

	Takovo Berry	Production	Organic	Blueberries	BE, NL, LU	**Number of employees**: 2 employees **Gender split:** 1 man and 1 woman **Education levels**: Employees have higher education in hospitality industry and agricultural engineering

Source: compiled by PPMI based on the interviews with the companies

Annex 3. ESCO occupational profiles and skills

The occupations presented in this annex are in demand among Western Balkan companies active in the three agri-food market niches (digitalisation solutions, biochemical and microbial products, and organic food). The occupations are primarily based on the interviews with businesses, and to a lesser extent on the interviews with other stakeholders, including business intermediary bodies and education and training providers. All these stakeholder groups were asked about the occupations and skills that companies in each market niche seek.

As the level of information provided differed from stakeholder to stakeholder, the list of demanded occupations was prepared following two strategies:

1. Some of the occupations were directly named by the interviewees as important. They were then matched to corresponding ESCO occupations.
2. Interviewees also mentioned specific skills and knowledge areas which are in demand. Based on these skills needs, we searched the ESCO skills and occupations database to extend the list of occupations that can be relevant for the market niches.

Digitalisation

Technical occupations

ICT- and machinery related technical occupations

Technology/ area	Corresponding ESCO occupations / Examples of ESCO skills & competences		Examples of ESCO essential knowledge	
Agricultural machinery and equipment	**Required educational level: ISCED 5 and above**			
	2144.1.2.1 - agricultural equipment design engineer			
	adjust engineering designs advise on safety improvements approve engineering design execute feasibility study perform scientific research provide technical documentation	read engineering drawings troubleshoot use CAD software use computer-aided engineering systems use technical drawing software	CAD software agricultural chemicals agricultural equipment industrial engineering legislation in agriculture manufacturing processes	e-agriculture mathematics mechanical engineering sustainable agricultural production principles technical drawings
	Required educational level: ISCED 2-4			
	8211.5 - motor vehicle assembler			
	align components assemble electrical components, electronic units, and metal parts bolt engine part keep records of work progress monitor manufacturing quality standards troubleshoot	read engineering drawings and standard blueprints supervise motor vehicles manufacture use technical documentation work in assembly line teams	electricity electromechanics electronics mechanics mechanics of motor vehicles motor vehicle parts drawings quality standards vehicle manufacturing process	
Mechatronics (robotics)	**Required educational level: ISCED 5 and above**			
	2144.1.11 - mechatronics engineer			

	adjust engineering designs analyse test data approve engineering design conduct literature research conduct quality control analysis define technical requirements design automation components develop mechatronic test procedures follow standards for machinery safety manage research data	monitor manufacturing quality standards operate open source software perform project management prepare production prototypes simulate mechatronic design concepts synthesise information test mechatronic units use technical drawing software	automation technology computer engineering control engineering design drawings electrical engineering electronics engineering principles engineering processes	mathematics mechanical engineering mechanics mechatronics physics robotics technical drawings
	3115.1.11 - mechatronics engineering technician			
	adjust engineering designs align components assemble mechatronic units assist scientific research fasten components follow standards for machinery safety inspect quality of products install mechatronic equipment	liaise with engineers perform test run prepare production prototypes read assembly drawings read engineering drawings record test data simulate mechatronic design concepts test mechatronic units	automation technology circuit diagrams computer engineering control engineering design drawings electrical engineering	electronics mechanical engineering mechatronics physics quality standards robotics
	Required educational level: ISCED 2-4			
	8211.3 - mechatronics assembler			
	align components a apply assembly and soldering techniques assemble mechatronic units clean components during assembly ensure conformity to specifications follow standards for machinery safety	install mechatronic equipment maintain mechatronic equipment perform metal work read assembly drawings read standard blueprints remove defective products troubleshoot	computer equipment electronics mechatronics quality standards safety engineering	
Sensing technologies	**Required educational level: ISCED 5 and above**			
	2149.12.1 - photonics engineer			
	adjust engineering designs analyse test data approve engineering design conduct literature research conduct quality control analysis demonstrate disciplinary expertise design optical prototypes design optical systems develop optical test procedures read engineering drawings record test data synthesise information test optical components	interact professionally in research and professional environments manage personal professional development manage research data model optical systems operate open source software operate scientific measuring equipment perform data analysis perform project management prepare production prototypes	design drawings electronics engineering principles lasers mathematics optical components optical engineering optical equipment types of optical instruments standards optical glass characteristics optical manufacturing process optics photonics physics refractive power	
	3111.13 - remote sensing technician			
	collect data using GPS collect real-time geolocation information execute analytical mathematical calculations interpret visual literacy	keep task records study aerial photos study radar images use geographic information systems	geodesy geographic information systems geography geomatics mathematics remote sensing techniques surveying photogrammetry	
	3114.1.10 - sensor engineering technician			

	adjust engineering designs align components apply soldering techniques assemble sensors assist scientific research fasten components inspect quality of products liaise with engineers test sensors	meet deadlines operate scientific measuring equipment prepare production prototypes read engineering drawings record test data solder electronics	circuit diagrams design drawings electronic equipment standards electronic test procedures electronics sensors	
IoT	**2529.3 - embedded systems security engineer**			
	analyse ICT system create flowchart diagram define security policies and technical requirements develop ICT device driver and software prototype execute software tests identify ICT security risks and system weaknesses interpret technical texts manage IT security compliances report test findings	perform risk analysis provide ICT consulting advice provide technical documentation use software design patterns and software libraries utilise computer-aided software engineering tools monitor system performance	ICT network security risks ICT security standards Internet of Things computer programming cyber attack counter-measures embedded systems information security strategy ICT debugging tools Internet of Things embedded systems	integrated development environment software tools for software configuration management mobile operating systems tools for software configuration management software anomalies
	2514.3 - industrial mobile devices software developer **2514.2.1 - embedded systems software developer**			
	analyse software specifications create flowchart diagram debug software design application interfaces develop software prototype interpret technical texts provide technical documentation	use different communication channels use software design patterns and software libraries utilise computer-aided software engineering tools	ICT debugging tools Internet of Things computer programming embedded systems industrial software integrated development environment software mobile operating systems tools for software configuration management	
Big data	**2511.3 - data analyst** **2511.4 - data scientist**			
	analyse big data apply statistical analysis techniques collect and integrate ICT data define data quality criteria establish data processes handle data samples use databases	manage and normalise data perform data cleansing and data mining use data processing techniques implement data quality processes	business intelligence data mining data models data quality assessment documentation types information confidentiality information extraction	information structure query languages resource description framework statistics unstructured data visual presentation techniques
Software development	**2512 - Software developers**			
	analyse software specifications create flowchart diagram debug software define technical requirements develop automated migration methods develop software prototype identify customer requirements interpret technical requirements	manage engineering project perform scientific research provide technical documentation use software design patterns, technical drawing software, software libraries and computer-aided software engineering tools	ICT debugging tools computer programming engineering principles engineering processes integrated development environment software technical drawings tools for software configuration management project management	
Electronics	**2152.1 - electronics engineer**			

	adjust engineering designs create technical plans design electrical and electronic systems develop electronic test procedures perform scientific research	execute feasibility study identify customer's needs manage budgets use technical drawing software write technical reports	design drawings electrical testing methods electricity principles electronics engineering principles	environmental legislation environmental threats mathematics mechanics physics
	Required educational level: ISCED 2-4			
	8212.3 - electronic equipment assembler			
	align components apply assembly and soldering techniques apply health and safety standards assemble electronic units ensure conformity to specifications fasten components	measure parts of manufactured products meet deadlines monitor manufacturing quality standards read assembly drawings report defective manufacturing materials	circuit diagrams electrical equipment regulations electronic equipment standards electronics integrated circuits printed circuit boards quality standards types of electronics	

Agri-food related technical occupations

Technology/ area	Corresponding ESCO occupations / Examples of ESCO skills & competences		Examples of ESCO essential knowledge
Agriculture	**Required educational level: ISCED 5 and above**		
	3142.1 - agricultural technician		
	analyse environmental, scientific, and test data execute analytical mathematical calculations conduct field work	gather experimental data maintain laboratory equipment write work-related reports apply safety procedures in laboratory	laboratory techniques
	2132.1 - agricultural scientist		
	advise on efficiency improvements manage personal professional development mentor individuals monitor the farm environmental management plan operate open source software perform market and scientific research provide advice to farmers provide advice to hatcheries publish academic research research livestock production draft scientific or academic papers and technical documentation manage open publications report pollution incidents report on environmental issues	advise on soil and water protection apply for research funding perform project management apply research ethics and scientific integrity principles in research activities communicate with a non-scientific audience create soil and plant improvement programmes develop professional network with researchers and scientists disseminate results to the scientific community manage intellectual property rights speak different languages synthesise information think abstractly	agroecology agroforestry bioeconomy e-agriculture environmental legislation in agriculture and forestry environmental policy livestock farming systems project management
	2145.1.4 - food technologist		

Food technology	analyse packaging requirements analyse samples of food and beverages apply GMP, HACCP, and food technology principles apply requirements concerning manufacturing of food and beverages assess HACCP implementation in plants collect samples for analysis describe chemical innovation in products develop food production processes ensure public safety and security evaluate ingredient documentation from suppliers follow-up lab results identify the factors causing changes in food during storage	keep up with innovations in food manufacturing lead process optimisation manage discarded products manage food manufacturing laboratory manage the use of additives in food manufacturing monitor developments used for food industry monitor processing conditions perform food risk analysis prepare visual data read engineering drawings strive for nutritional improvement of food manufacturing use new technologies in food manufacturing watch food product trends write work-related reports Interpret data in food manufacturing improve chemical processes	bioeconomy biotechnology chemistry combination of flavours combination of textures enzymatic processing fermentation processes of food food allergies food canning production line food engineering food legislation food preservation food products composition food safety principles food science food storage food toxicity food waste monitoring systems foodborne diseases	health, safety and hygiene legislation ingredient threats laboratory-based sciences legislation about animal origin products molecular gastronomy pathogenic microorganisms in food processes of foods and beverages manufacturing quality assurance methodologies risks associated to physical, chemical, biological hazards in food and beverages traceability in food industry functional properties of foods
Agronomy	**2132.2 - agronomist**			
	apply horticultural standards and practices apply safety procedures in laboratory consult with business clients execute analytical mathematical calculations gather experimental data use agricultural information systems and databases write work-related reports	maintain laboratory equipment manage livestock manage nutrients perform laboratory tests research improvement of crop yields supervise hygiene procedures in agricultural settings	agroecology agronomy biology budgetary principles consultation methods crop production principles environmental legislation in agriculture and forestry European pesticide legislation	laboratory techniques livestock species mathematics pest control in plants plant disease control plant harvest methods plant propagation irrigation systems horticulture principles

Business support occupations

Area	Corresponding ESCO occupations / ESCO skills & competences		ESCO essential knowledge
Inter-nationalisation	**Required educational level: ISCED 5 and above**		
	1324.3.2 - import export manager, e.g: **1324.3.2.1 - import export manager in agricultural machinery and equipment** **1324.3.2.11 - import export manager in electronic and telecommunications equipment** **1324.3.2.8 - import export manager in computers, peripheral equipment and software**		
	abide by business ethical code of conducts apply conflict management build rapport with people from different cultural backgrounds comprehend financial business terminology conduct performance measurement control trade commercial documentation create solutions to problems direct distribution operations ensure customs compliance	have computer literacy maintain financial records manage processes meet deadlines monitor international market performance perform financial risk management in international trade produce sales reports set import export strategies speak different languages	embargo regulations export control principles international commercial transactions rules international import export regulations

	3331.2.1 - import export specialist, e.g. **3331.2.1.11 - import export specialist in electronic and telecommunications equipment** **3331.2.1.8 - import export specialist in computers, peripheral equipment and software** **3331.2.1.1 - import export specialist in agricultural machinery and equipment**		
	administer multi-modal logistics apply conflict management apply export strategies apply for refunds apply import strategies arrange customs documents arrange customs inspection build rapport with people from different cultural backgrounds communicate with shipment forwarders create import-export commercial documentation create solutions to problems	ensure customs compliance file claims with insurance companies handle carriers handle quotes from prospective shippers have computer literacy manage import export licenses meet deadlines monitor merchandise delivery perform clerical duties plan transport operations speak different languages	embargo regulations international commercial transactions rules international import export regulations value-added tax law
Sales	**2433.6.1 - technical sales representative in agricultural machinery and equipment** **2434.4 - technical sales representative in electronic and telecommunications equipment**		
	answer requests for quotation apply technical communication skills communicate with customers contact customers demonstrate motivation for sales demonstrate products' features ensure client orientation ensure compliance with legal requirements guarantee customer satisfaction have computer literacy use customer relationship management software	implement customer follow-up implement marketing strategies implement sales strategies keep records of customer interaction keep records on sales maintain relationship with customers manage answer requests for quotation apply technical communication skills	agricultural equipment / electronic and telecommunication equipment characteristics of products characteristics of services product comprehension sales promotion techniques
	3324.4.1 - wholesale merchant in agricultural machinery and equipment **3324.4.8 - wholesale merchant in computers, computer peripheral equipment and software**		
	assess supplier risks build business relationships comprehend financial business terminology have computer literacy identify customer's needs and new business opportunities identify suppliers initiate contact with buyers and sellers	maintain financial records monitor international market performance negotiate buying conditions negotiate sale of commodities negotiate sales contracts perform market research plan transport operations	agricultural equipment / computer equipment product comprehension sales strategies
Marketing	**1221.5 - digital marketing manager**		
	analyse consumer buying trends conduct online competitive analysis design brand's online communication plan identify new business opportunities plan social media marketing campaigns	perform business analysis perform customers' needs analysis perform market research set brand positioning integrate marketing strategies with the global strategy	brand marketing techniques digital marketing techniques e-commerce systems mobile marketing neuromarketing techniques online ads campaign techniques social media management social media marketing techniques web analytics
	2431.10 - marketing consultant **2431.11 - market research analyst**		
	advise on market strategies analyse consumer buying trends analyse economic trends analyse external and internal factors of companies analyse market financial trends prepare market research reports	identify customer's needs identify market niches identify potential markets for companies make strategic business decisions perform market research prepare presentation material	market research marketing department processes marketing mix marketing principle statistics trendwatching visual presentation techniques project management
	2431.3 - advertising specialist		

	brainstorm and develop creative ideas develop professional network give live presentation	liaise with advertising agencies perform market research persuade clients with alternatives identify customer's needs	advertising techniques copyright legislation
Accounting	**2411.1 – accountant** **3313.1 - accounting assistant**		
	analyse financial performance of a company attach accounting certificates to accounting transactions calculate tax check accounting records draft accounting procedures ensure compliance with accounting conventions explain accounting records follow the statutory obligations identify accounting errors	perform balance sheet operations prepare financial statements prepare tax returns forms prepare trial accounting balances allocate bills issue sales invoices perform business research interpret financial statements manage accounts use accounting and office systems	accounting department processes accounting entries accounting techniques bookkeeping regulations commercial law depreciation financial department processes financial statements fraud detection statistics tax legislation
Human Resources	**1212.2 - human resources manager**		
	apply company policies comply with legal regulations coordinate operational activities develop employee retention programs develop training programmes ensure gender equality in the workplace identify necessary human resources identify with the company's goals	manage budgets monitor company policy negotiate employment agreements negotiate with employment agencies support employability of people with disabilities track key performance indicators	employment law human resource management human resources department processes labour legislation outplacement
	Required educational level: ISCED 2-4		
	4416.1 - human resources assistant		
	administer appointments apply company policies document interviews fix meetings identify with the company's goals listen actively maintain professional administration	manage payroll reports observe confidentiality profile peoples upport managers use communication techniques write work-related reports	job market offers
Legal	**Required educational level: ISCED 5 and above**		
	2619.7 - legal consultant		
	advise on legal decisions analyse legal enforceability compile legal documents identify clients' needs interpret law	protect client interests provide legal advice use consulting techniques ensure law application	legal terminology
Supply chain & logistics	**1324.8 - supply chain manager**		
	analyse logistic changes analyse supply chain strategies and trends assess supplier risks estimate costs of required supplies follow company standards identify key processes of traceability systems liaise with managers	maintain relationship with customers and suppliers manage inventory manage supplies order supplies strive for company growth identify software for warehouse management	corporate social responsibility product data management product life-cycle supplier management supply chain management supply chain principles
	1324.3.1.6.1 - agricultural machinery and equipment distribution manager **1324.3.1.6.8 - computers, computer peripheral equipment and software distribution manager**		

	adhere to organisational guidelines carry out inventory control accuracy carry out statistical forecasts communicate with shipment forwarders create solutions to problems develop financial statistics reports ensure customs compliance ensure regulatory compliance concerning distribution activities forecast distribution activities handle carriers perform risk analysis have computer literacy	implement strategic planning manage financial risk manage freight payment methods manage staff minimise shipping cost perform financial risk management in international trade perform multiple tasks at the same time plan transport operations track shipments track shipping sites	agricultural equipment/ computer equipment freight transport methods hazardous freight regulations supply chain management
	2421.5 - logistics analyst		
	analyse relation between supply chain improvement and profit analyse supply chain strategies analyse supply chain trends analyse transport business networks consider economic criteria in decision making create freight rate databases develop efficiency plans for logistics operations enhance production workflow liaise with logistics management teams use spreadsheets software	maintain logistics databases manage logistics pricing systems mitigate waste of resources perform system analysis review distribution management procedures support development of annual budget detect bottlenecks use methods of logistical data analysis use specific data analysis software	green logistics supply chain management theory of constraints
Business management, project management	**1213.5 - business manager**		
	abide by business ethical code of conducts analyse business objectives and processes ensure lawful business operations plan medium to long term objectives assume responsibility for the build business relationships conclude business agreements plan health and safety procedures create a work atmosphere of continuous improvement develop an organisational structure track key performance indicators develop company strategies develop revenue generation strategies	exercise stewardship follow company standards hire new personnel integrate strategic foundation in daily performance liaise with managers make strategic business decisions management of a business manage staff negotiate with stakeholders apply business acumen strive for company growth create a financial plan control financial resources develop business plans	business law business management principles company policies corporate social responsibility cost management financial forecasting risk identification strategic planning
	1219.6 - project manager		
	apply change management apply conflict management build business relationships control of expenses create project specifications customise project methodologies draft project documentation ensure compliance with legal requirements ensure equipment availability and maintenance establish daily priorities estimate duration of work	follow company standards identify legal requirements liaise with managers manage budgets, logistics, project changes, project information, project metrics, staff, and supplies negotiate with stakeholders organise project meetings perform PESTEL analysis perform resource planning perform risk analysis	communication principles internal risk management policy project management project management methodology (PM²) project management principles

	train employees	provide cost benefit analysis reports	

Biochemical and microbial products for agriculture

Technical occupations

Technology/ area	Corresponding ESCO occupations / Examples of ESCO skills & competences		Examples of ESCO essential knowledge	
Agriculture	**Required educational level: ISCED 5 and above**			
	3142.1 - agricultural technician			
	analyse environmental, scientific, and test data execute analytical mathematical calculations conduct field work	gather experimental data maintain laboratory equipment write work-related reports apply safety procedures in laboratory	laboratory techniques	
	2132.1 - agricultural scientist			
	advise on efficiency improvements manage personal professional development mentor individuals monitor the farm environmental management plan operate open source software perform market and scientific research provide advice to farmers provide advice to hatcheries publish academic research research livestock production draft scientific or academic papers and technical documentation manage open publications report pollution incidents report on environmental issues	advise on soil and water protection apply for research funding perform project management apply research ethics and scientific integrity principles in research activities communicate with a non-scientific audience create soil and plant improvement programmes develop professional network with researchers and scientists disseminate results to the scientific community manage intellectual property rights speak different languages synthesise information think abstractly	agroecology agroforestry bioeconomy e-agriculture environmental legislation in agriculture and forestry environmental policy livestock farming systems project management	
	2133.11 - soil scientist			
	advise on nature conservation apply safety procedures in laboratory conduct soil sample tests	gather experimental data perform laboratory tests write work-related reports	European pesticide legislation crop production principles geology	soil mechanics soil science soil structure ecology
	2145.1.4 - food technologist			

Food technology	analyse packaging requirements analyse samples of food and beverages apply GMP, HACCP, and food technology principles apply requirements concerning manufacturing of food and beverages assess HACCP implementation in plants collect samples for analysis describe chemical innovation in products develop food production processes evaluate ingredient documentation from suppliers follow-up lab results identify the factors causing changes in food during storage	keep up with innovations in food manufacturing lead process optimisation manage discarded products manage food manufacturing laboratory manage the use of additives in food manufacturing monitor developments used for food industry monitor processing conditions perform food risk analysis prepare visual data read engineering drawings strive for nutritional improvement of food manufacturing use new technologies in food manufacturing watch food product trends write work-related reports improve chemical processes	bioeconomy biotechnology chemistry combination of flavours combination of textures enzymatic processing fermentation processes of food food allergies food canning production line food engineering food legislation food preservation food products composition food safety principles food science food storage food toxicity food waste monitoring systems foodborne diseases	health, safety and hygiene legislation ingredient threats laboratory-based sciences legislation about animal origin products molecular gastronomy pathogenic microorganisms in food processes of foods and beverages manufacturing quality assurance methodologies risks associated to physical, chemical, biological hazards in food and beverages traceability in food industry functional properties of foods
	2131.5 - food biotechnologist			
	analyse samples of food and beverages apply GMP and HACCP detect microorganisms ensure public safety and security follow-up lab results identify the factors causing changes in food during storage improve chemical processes keep up with innovations in food manufacturing	manage discarded products manage food manufacturing laboratory monitor developments used for food industry monitor processing conditions operate microscope perform food risk analysis perform microbiological analysis in food prepare visual data lead process optimisation	biotechnology enzymatic processing fermentation processes of beverages and food food allergies food and beverage industry food legislation food preservation food product ingredients food safety principles food science food toxicity	ingredient threats laboratory-based sciences legislation about animal origin products molecular gastronomy pathogenic microorganisms in food quality assurance methodologies foodborne diseases food storage
	3111.3 - food analyst			
	analyse samples of food and beverages apply GMP apply HACCP apply requirements concerning manufacturing of food and beverages assess nutritional characteristics of food assess quality characteristics of food products blend food ingredients preserve samples calibrate laboratory equipment collect samples for analysis conduct food tests ensure public safety and security	interpret data in food manufacturing keep food laboratory inventory keep up-to-date with regulations maintain laboratory equipment measure pH perform physico-chemical analysis to food materials prepare visual data pursue excellence in the creation of food products report test findings set quality assurance objectives identify the factors causing changes in food during storage	food safety principles food safety standards food science food toxicity ingredient threats laboratory-based sciences pathogenic microorganisms in food quality assurance methodologies	
Agricultural engineering	**2144.1.2 - agricultural engineer**			
	approve engineering design execute feasibility study use technical drawing software	troubleshoot assess financial viability adjust engineering designs perform scientific research	e-agriculture engineering principles and processes legislation in agriculture mechanical engineering technical drawings	

<table>
<tr><td rowspan="2">Agronomy</td><td colspan="4">2132.2 - agronomist</td></tr>
<tr><td>apply horticultural standards and practices
apply safety procedures in laboratory
consult with business clients
execute analytical mathematical calculations
maintain laboratory equipment
use agricultural information systems and databases</td><td>manage livestock
manage nutrients
perform laboratory tests
research improvement of crop yields
gather experimental data
supervise hygiene procedures in agricultural settings
write work-related reports</td><td>agroecology
agronomy
biology
budgetary principles
consultation methods
environmental legislation in agriculture and forestry
European pesticide legislation</td><td>laboratory techniques
livestock species
mathematics
pest control in plants
plant disease control
plant harvest methods
plant propagation
irrigation systems
horticulture principles</td></tr>
<tr><td rowspan="4">Biology
Biotechnology
Genetics</td><td colspan="3">2131.3 - bioinformatics scientist
2131.4.8 – geneticist
2131.4.10 – microbiologist</td></tr>
<tr><td>apply research ethics and scientific integrity principles in research activities
apply scientific methods
collect biological data
collect samples for analysis
communicate with a non-scientific audience
conduct research on fauna/flora
demonstrate disciplinary expertise
detect microorganisms
disseminate results to the scientific community
draft scientific or academic papers and technical documentation
evaluate research activities
gather experimental data
think abstractly
evaluate genetic data</td><td>manage intellectual property rights
manage open publications
manage personal professional development
manage research data
mentor individuals
operate open source software
perform project management
perform scientific research
promote open innovation in research
promote the transfer of knowledge publish academic research
send biological samples to laboratory
speak different languages
synthesise information
apply statistical analysis techniques</td><td>biology
biotechnology
botany
clinical cytology
medical genetics
microbiology-bacteriology
molecular biology
pathogenic microorganisms
scientific research methodology
virology
genetic engineering
genetics
medical genetics
computer engineering
computer equipment
computer programming
database management systems
statistics
web programming</td></tr>
<tr><td colspan="3">3141.2.3 - biology technician
3141.2.1 - bacteriology technician</td></tr>
<tr><td>analyse experimental laboratory data
apply safety procedures in laboratory
apply scientific methods
asist in the production of laboratory documentation
calibrate laboratory equipment
use laboratory equipment</td><td>collect biological data
collect samples for analysis
maintain laboratory equipment
manage inventory
perform laboratory tests
perform scientific research
write technical reports</td><td>biology
microbiology-bacteriology
laboratory equipment
laboratory techniques
scientific research methodology</td></tr>
<tr><td rowspan="2">Chemical technology</td><td colspan="3">2113.1 – chemist
2131.4.2 - biochemist</td></tr>
<tr><td>analyse chemical substances
apply liquid chromatography
apply safety procedures in laboratory
calibrate laboratory equipment
communicate with a non-scientific audience
develop chemical product
document analysis results
draft scientific or academic papers and technical documentation
manage chemical testing procedures</td><td>mentor individuals
operate open source software
perform project management
perform scientific research
prepare chemical samples
run laboratory simulations
speak different languages
synthesise information
test chemical samples
think abstractly
translate formulae into processes
use chemical analysis equipment</td><td>analytical chemistry
inorganic chemistry
laboratory techniques
physics
biological chemistry
biology
biotechnology
communicable diseases
genetics
molecular biology
pharmaceutical chemistry
pharmacology</td></tr>
</table>

	manage personal professional development use chromatography software use personal protection equipment	write scientific publications write technical reports	
	3141.2.2 - biochemistry technician		
	analyse experimental laboratory data apply safety procedures in laboratory assist in the production of laboratory documentation calibrate laboratory equipment	collect samples for analysis maintain laboratory equipment manage inventory perform laboratory tests use laboratory equipment write technical reports	biological chemistry biology biotechnology genetics laboratory equipment laboratory techniques scientific research methodology
Environment	**2133.5 - ecologist**		
	analyse ecological data apply for research funding apply research ethics and scientific integrity principles in research activities communicate with a non-scientific audience conduct ecological research conduct ecological surveys draft scientific or academic papers and technical documentation employ habitat survey techniques identify plants characteristics manage habitats manage intellectual property rights manage open publications write work-related reports	manage personal professional development manage research data measure trees mentor individuals operate open source software perform project management perform scientific research promote open innovation in research promote the participation of promote the transfer of knowledge publish academic research speak different languages synthesise information think abstractly	agroecology biology ecology environmental legislation organism taxonomy
	2143.2 - environmental expert		
	advise on environmental remediation advise on pollution prevention analyse environmental data assess environmental impact carry out environmental audits collect samples for analysis conduct environmental surveys develop environmental remediation strategies develop environmental policy	investigate pollution measure pollution perform environmental investigations provide training in sustainable tourism development and management report on environmental issues report pollution incidents create solutions to problems	environmental legislation environmental policy environmental threats pollution legislation pollution prevention scientific research methodology
Veterinary	**2250.6 - general veterinarian** **3240.2 - veterinary technician**		
	apply safe work practices in a veterinary setting assist in administering veterinary anaesthetics assist in general veterinary medical procedures assist in the administration of fluids to animals assist in veterinary surgery control animal movement handle veterinary emergencies	manage animal biosecurity manage infection control in the facility monitor the welfare of animals prepare animals for anaesthesia prepare animals for veterinary surgery	anatomy of animals animal behaviour animal welfare animal welfare legislation biosecurity related to animals environmental enrichment for animals physiology of animals safe work practices in a veterinary setting signs of animal illness

		provide first aid to animals support veterinary diagnostic procedures	

Business support occupations

Area	Corresponding ESCO occupations / ESCO skills & competences		ESCO essential knowledge
Communication and customer care	**Required educational level: ISCED 5 and above**		
	1222.1 - communication manager		
	advise on communication strategies advise on public image analyse external factors of companies analyse internal factors of companies develop communications strategies develop communications strategies integrate strategic foundation in daily performance	perform public relations proofread text protect client interests identify clients' needs prepare presentation material apply diplomatic principles compile content identify clients' needs use different communication channels	communication principles corporate social responsibility diplomatic principles ethics of sharing work through social media forming of public opinion grammar market research office software rhetoric strategic planning
	2431.6 - client relations manager		
	advise on public relations analyse consumer buying trends build business relationships communicate with customers create solutions to problems develop professional network perform customers' needs analysis follow company standards guarantee customer satisfaction identify customer's needs identify new business opportunities	liaise with managers manage accounts manage customer service manage staff maximise sales revenues plan health and safety procedures supervise the management of an establishment fix meetings supervise work	communication principles corporate social responsibilit product comprehension public relations
	Required educational level: ISCED 2-4		
	4225.1 - customer service representative		
	apply knowledge of human behaviour create solutions to problems determine charges for customer services guarantee customer satisfaction keep records of customer interaction perform multiple tasks at the same time process data process order forms with customer's information provide customer follow-up services	apply conflict management communicate with customers process customer orders provide information control of expenses ensure client orientation process refunds perform escalation procedure manage schedule of tasks listen actively have computer literacy implement customer follow-up	customer service
Inter-nationalisation	**Required educational level: ISCED 5 and above**		
	1324.3.2 - import export manager		

	abide by business ethical code of conducts apply conflict management build rapport with people from different cultural backgrounds comprehend financial business terminology conduct performance measurement control trade commercial documentation create solutions to problems direct distribution operations ensure customs compliance	have computer literacy maintain financial records manage processes meet deadlines monitor international market performance perform financial risk management in international trade produce sales reports set import export strategies speak different languages	embargo regulations export control principles international commercial transactions rules international import export regulations
	3331.2.1 - import export specialist		
	administer multi-modal logistics apply conflict management apply export strategies apply for refunds apply import strategies arrange customs documents arrange customs inspection build rapport with people from different cultural backgrounds communicate with shipment forwarders create import-export commercial documentation create solutions to problems	ensure customs compliance file claims with insurance companies handle carriers handle quotes from prospective shippers have computer literacy manage import export licenses meet deadlines monitor merchandise delivery perform clerical duties plan transport operations speak different languages	embargo regulations international commercial transactions rules international import export regulations value-added tax law
Marketing and sales	**1221.3.2 - marketing manager** **1221.5 - digital marketing manager**		
	analyse consumer buying trends conduct online competitive analysis design brand's online communication plan identify new business opportunities plan social media marketing campaigns	perform business analysis perform customers' needs analysis perform market research set brand positioning integrate marketing strategies with the global strategy	brand marketing techniques digital marketing techniques market pricing e-commerce systems mobile marketing neuromarketing techniques online ads campaign techniques social media management social media marketing techniques web analytics
	2431.10 - marketing consultant **2431.11 - market research analyst**		
	advise on market strategies analyse consumer buying trends analyse economic trends analyse external and internal factors of companies analyse market financial trends prepare market research reports	identify customer's needs identify market niches identify potential markets for companies make strategic business decisions perform market research prepare presentation material	market research marketing department processes marketing mix marketing principle statistics trendwatching visual presentation techniques project management
	2431.3 - advertising specialist		
	brainstorm and develop creative ideas develop professional network give live presentation	liaise with advertising agencies perform market research persuade clients with alternatives identify customer's needs	advertising techniques copyright legislation
	2433.6 - technical sales representative **3322.1 - commercial sales representative**		
	advise on merchandise feature answer requests for quotation apply technical communication skills carry out sales analysis communicate with customers demonstrate motivation for sales demonstrate products' features	guarantee customer satisfaction have computer literacy implement customer follow-up implement sales strategies keep records of customer interaction	characteristics of products characteristics of services customer relationship management product comprehension sales promotion techniques sales strategies

	ensure client orientation ensure compliance with legal requirements ensure compliance with purchasing and contracting regulations use customer relationship management software respond to customers' inquiries	keep records on sales maintain relationship with suppliers produce sales reports prospect new customers prospect new regional contracts record customers' personal data	
Financial management	**1211.1 - financial manager**		
	advise on financial matters analyse financial performance of a company analyse market financial trends create a financial plan enforce financial policies	follow company standards liaise with managers plan health and safety procedures strive for company growth	financial analysis financial management financial statements

Organic food

Technical occupations

Area	Corresponding ESCO occupations / Examples of ESCO skills & competences		Examples of ESCO essential knowledge	
Agriculture Agronomy Farm management	**Required educational level: ISCED 5 and above**			
	3142.1 - agricultural technician			
	analyse environmental, scientific, and test data execute analytical mathematical calculations conduct field work	gather experimental data maintain laboratory equipment write work-related reports apply safety procedures in laboratory	laboratory techniques	
	2132.1 - agricultural scientist			
	advise on efficiency improvements manage personal professional development mentor individuals monitor the farm environmental management plan operate open source software perform market and scientific research provide advice to farmers provide advice to hatcheries publish academic research research livestock production draft scientific or academic papers and technical documentation manage open publications report on environmental issues	advise on soil and water protection apply for research funding perform project management apply research ethics and scientific integrity principles in research activities communicate with a non-scientific audience create soil and plant improvement programmes develop professional network with researchers and scientists disseminate results to the scientific community manage intellectual property rights speak different languages synthesise information think abstractly report pollution incidents	agroecology agroforestry bioeconomy e-agriculture environmental legislation in agriculture and forestry environmental policy livestock farming systems project management	
	2132.2 - agronomist			
	apply horticultural standards and practices apply safety procedures in laboratory consult with business	maintain laboratory equipment manage livestock manage nutrients perform laboratory tests	agroecology agronomy biology budgetary principles consultation	laboratory techniques livestock species mathematics pest control in plants plant disease control

	clients execute analytical mathematical calculations gather experimental data use agricultural information systems and databases write work-related reports	research improvement of crop yields supervise hygiene procedures in agricultural settings	methods crop production principles environmental legislation in agriculture and forestry European pesticide legislation	plant harvest methods plant propagation irrigation systems horticulture principles
	Required educational level: ISCED 2-4			
	6130.1 - farm manager			
	assess new farming technologies manage production enterprise supervise hygiene procedures in agricultural settings	market farm products negotiate loan agreements operate farm equipment present the farm facilities manage farm products manage farm supplies	agricultural business management agronomical production principles environmental policy pollution prevention	
	6114.1 - crop production manager			
	ensure soil fertility execute disease and pest control activities maintain storage facilities maintain technical equipment manage agricultural staff manage production enterprise monitor fields	operate agricultural machinery store crops store products supervise crop production supervise hygiene procedures in agricultural settings	agronomical production principles crop production principles ecology environmental legislation in agriculture and forestry fertilisation principles health and safety regulations leadership principles pest control and plant disease control plant harvest methods soil structure technical equipment for crop production types of storage facilities	
	6111.1 - agronomic crop production team leaders			
	ensure soil fertility execute disease and pest control activities execute fertilisation manage agricultural staff monitor fields prepare planting area prepare equipment for harvest supervise hygiene procedures in agricultural settings	operate agricultural machinery maintain plant health maintain plant soil nutrition maintain storage facilities maintain technical equipment grow plants harvest crop propagate plants store crops and products	agroecology agroforestry agronomical production principles crop production principles ecology environmental legislation in agriculture and forestry fertilisation principles health and safety regulations pest control and plant disease control plant harvest methods plant propagation plant species soil structure technical equipment for crop production types of storage facilities	
	6113.2 - horticulture production manager			
	coordinate greenhouse environment create soil and plant improvement programmes develop agricultural production plans make independent operating decisions monitor fields manage production enterprise use agricultural information systems and databases maintain storage facilities	ensure soil fertility execute disease and pest control activities maintain plant health optimise production propagate plants prune plants store crops and products supervise crop production operate horticulture equipment maintain plant soil nutrition supervise hygiene procedures in agricultural settings	budgetary principles horticulture and crop production principles environmental legislation in agriculture and forestry fertilisation principles greenhouse types health and safety regulations leadership principles pest control and plant disease control plant harvest methods plant propagation project management principles pruning techniques and types quality criteria for storage facilities soil structure	
	Required educational level: ISCED 1			

	9213.1 - crop production worker		
	execute disease and pest control activities execute fertilisation grow plants harvest crop maintain storage facilities monitor fields	operate agricultural machinery prepare equipment for harvest prepare planting area propagate plants store crops and products	agroforestry
	9214.2 - horticulture worker		
	execute fertilisation maintain gardening equipment maintain storage facilities maintain the greenhouse store crops and products supervise hygiene procedures in agricultural settings	grow plants harvest crop monitor fields nurse plants prepare planting area propagate plants prune plants use gardening equipment	
Machinery operators	**Required educational level: ISCED 2-4**		
	8341.2 - land-based machinery operator		
	follow written instructions handling chemical products for soil and plants tow a tractor implement using the power take-off work in a land-based team	harvest crop identify plants characteristics operate agricultural machinery spread fertiliser	herbicides mechanical tools pesticides plant disease control road traffic laws
	6112.5 - vineyard machinery operator		
	execute disease and pest control activities execute fertilisation harvest grapes maintain vineyard machinery	operate agricultural machinery perform hand pruning perform trellis repairs plant vine yards manage canopy	environmental legislation in agriculture and forestry pest control in plants plant disease control
Veterinary	**Required educational level: ISCED 5 and above**		
	3240.2 - veterinary technician		
	apply safe work practices in a veterinary setting assist in administering veterinary anaesthetics assist in general veterinary medical procedures assist in the administration of fluids to animals control animal movement handle veterinary emergencies	manage animal biosecurity manage infection control in the facility monitor the welfare of animals prepare animals for anaesthesia prepare animals for veterinary surgery provide first aid to animals support veterinary diagnostic procedures assist in veterinary surgery	anatomy of animals animal behaviour animal welfare animal welfare legislation biosecurity related to animals environmental enrichment for animals physiology of animals safe work practices in a veterinary setting signs of animal illness
Agricultural engineering	**2144.1.2 - agricultural engineer**		
	approve engineering design execute feasibility study use technical drawing software	troubleshoot assess financial viability adjust engineering designs perform scientific research	e-agriculture engineering principles and processes legislation in agriculture mechanical engineering technical drawings
	2145.1.4 - food technologist		

Food technology	analyse packaging requirements analyse samples of food and beverages apply GMP, HACCP, and food technology principles apply requirements concerning manufacturing of food and beverages assess HACCP implementation in plants collect samples for analysis describe chemical innovation in products develop food production processes ensure public safety and security evaluate ingredient documentation from suppliers follow-up lab results identify the factors causing changes in food during storage	keep up with innovations in food manufacturing lead process optimisation manage discarded products manage food manufacturing laboratory manage the use of additives in food manufacturing monitor developments used for food industry monitor processing conditions perform food risk analysis prepare visual data read engineering drawings strive for nutritional improvement of food manufacturing use new technologies in food manufacturing watch food product trends write work-related reports Interpret data in food manufacturing improve chemical processes	bioeconomy biotechnology chemistry combination of flavours combination of textures enzymatic processing fermentation processes of food food allergies food canning production line food engineering food legislation food preservation food products composition food safety principles food science food storage food toxicity food waste monitoring systems foodborne diseases	health, safety and hygiene legislation ingredient threats laboratory-based sciences legislation about animal origin products molecular gastronomy pathogenic microorganisms in food processes of foods and beverages manufacturing quality assurance methodologies risks associated to physical, chemical, biological hazards in food and beverages traceability in food industry functional properties of foods
	2263.2 - food safety specialist			
	develop food safety programmes evaluate retail food inspection findings investigate complaints related to consumer protection plan inspections for prevention of sanitation violations train employees	control food safety regulations keep task records monitor packaging operations take action on food safety violations maintain personal hygiene standards prepare reports on sanitation	food legislation food preservation food storage	
	3119.5 - food technician			
	apply GMP and HACCP apply requirements concerning manufacturing of food and beverages carry out checks of production plant equipment clean food and beverage machinery handle delivery of raw materials manage packaging material	identify the factors causing changes in food during storage monitor ingredient storage monitor the production line schedule regular machine maintenance set up equipment for food production write work-related reports monitor freezing processes	food and beverage industry food preservation food product ingredients food waste monitoring systems functional properties of foods molecular gastronomy pathogenic microorganisms in food processes of foods and beverages manufacturing quality assurance methodologies	
	2131.5 - food biotechnologist			
	analyse samples of food and beverages apply GMP and HACCP detect microorganisms ensure public safety and security identify the factors causing changes in food during storage improve chemical processes	manage food manufacturing laboratory monitor developments used for food industry monitor processing conditions operate microscope perform food risk analysis perform microbiological analysis in food prepare visual data	Biotechnology enzymatic processing fermentation processes of beverages and food food allergies food legislation food preservation food product ingredients and composition food safety principles food science food storage food toxicity foodborne diseases	

	keep up with innovations in food manufacturing manage discarded products	lead process optimisation follow-up lab results	ingredient threats laboratory-based sciences legislation about animal origin products molecular gastronomy pathogenic microorganisms in food quality assurance methodologies
	Required educational level: ISCED 2-4		
	8160.34 - food production operator		
	administer ingredients in food production apply GMP and HACCP apply requirements concerning manufacturing of food and beverages be at ease in unsafe environments carry out checks of production plant equipment monitor ingredient storage monitor the production line	clean food and beverage machinery disassemble equipment ensure refrigeration of food in the supply chain ensure sanitation follow production schedule keep inventory of goods in production lift heavy weights support management of raw materials	food safety principles food waste monitoring systems
Environment	**Required educational level: ISCED 5 and above**		
	2133.5 - ecologist		
	analyse ecological data apply for research funding apply research ethics and scientific integrity principles in research activities communicate with a non-scientific audience conduct ecological research conduct ecological surveys draft scientific or academic papers and technical documentation employ habitat survey techniques identify plants characteristics manage habitats manage intellectual property rights manage open publications write work-related reports	manage personal professional development manage research data measure trees mentor individuals operate open source software perform project management perform scientific research promote open innovation in research promote the participation of promote the transfer of knowledge publish academic research speak different languages synthesise information think abstractly	agroecology biology ecology environmental legislation organism taxonomy
	2143.2 - environmental expert		
	advise on environmental remediation advise on pollution prevention analyse environmental data assess environmental impact carry out environmental audits collect samples for analysis conduct environmental surveys create solutions to problems develop environmental policy	investigate pollution measure pollution perform environmental investigations provide training in sustainable tourism development and management report on environmental issues report pollution incidents develop environmental remediation strategies	environmental legislation environmental policy environmental threats pollution legislation pollution prevention scientific research methodology

Business support occupations

Area	Corresponding ESCO occupations / ESCO skills & competences		ESCO essential knowledge
Inter-nationalisation	**Required educational level: ISCED 5 and above**		
	1324.3.2 - import export manager		
	abide by business ethical code of conducts apply conflict management build rapport with people from different cultural backgrounds comprehend financial business terminology conduct performance measurement control trade commercial documentation create solutions to problems direct distribution operations ensure customs compliance	have computer literacy maintain financial records manage processes meet deadlines monitor international market performance perform financial risk management in international trade produce sales reports set import export strategies speak different languages	embargo regulations export control principles international commercial transactions rules international import export regulations
	3331.2.1 - import export specialist		
	administer multi-modal logistics apply conflict management apply export strategies apply for refunds apply import strategies arrange customs documents arrange customs inspection build rapport with people from different cultural backgrounds communicate with shipment forwarders create import-export commercial documentation create solutions to problems	ensure customs compliance file claims with insurance companies handle carriers handle quotes from prospective shippers have computer literacy manage import export licenses meet deadlines monitor merchandise delivery perform clerical duties plan transport operations speak different languages	embargo regulations international commercial transactions rules international import export regulations value-added tax law
Marketing	**1221.5 - digital marketing manager**		
	analyse consumer buying trends design brand's online communication plan identify new business opportunities plan social media marketing campaigns	conduct online competitive analysis perform business and customers' needs analysis perform market research set brand positioning integrate marketing strategies with the global strategy	brand marketing techniques digital marketing techniques e-commerce systems mobile marketing neuromarketing techniques online ads campaign techniques social media management social media marketing techniques web analytics web strategy assessment
	2431.10 - marketing consultant **2431.11 - market research analyst**		
	advise on market strategies analyse consumer buying trends analyse economic trends analyse external and internal factors of companies analyse market financial trends prepare market research reports	identify customer's needs identify market niches identify potential markets for companies make strategic business decisions perform market research prepare presentation material	market research marketing department processes marketing mix marketing principle statistics trendwatching visual presentation techniques project management
	2431.3 - advertising specialist		
	brainstorm and develop creative ideas develop professional network give live presentation identify customer's needs	liaise with advertising agencies perform market research persuade clients with alternatives	advertising techniques copyright legislation
Project management	**1219.6 - project manager**		
	apply change management apply conflict management build business relationships	follow company standards identify legal requirements liaise with managers	communication principles internal risk management policy project management

Financial management **Business management**	control of expenses create project specifications customise project methodologies draft project documentation ensure compliance with legal requirements ensure equipment availability and maintenance establish daily priorities estimate duration of work train employees	manage budgets, logistics, project changes, project information, project metrics, staff, and supplies negotiate with stakeholders organise project meetings perform PESTEL analysis perform resource planning perform risk analysis provide cost benefit analysis reports	project management methodology (PM²) project management principles
	1211.1 - financial manager		
	advise on financial matters analyse financial performance of a company analyse market financial trends create a financial plan enforce financial policies	follow company standards liaise with managers plan health and safety procedures strive for company growth	financial analysis financial management financial statements
	1213.5 - business manager		
	abide by business ethical code of conducts analyse business objectives and processes ensure lawful business operations plan medium to long term objectives assume responsibility for the build business relationships conclude business agreements plan health and safety procedures create a work atmosphere of continuous improvement develop an organisational structure track key performance indicators develop company strategies	exercise stewardship follow company standards hire new personnel integrate strategic foundation in daily performance liaise with managers make strategic business decisions management of a business manage staff negotiate with stakeholders apply business acumen strive for company growth create a financial plan control financial resources develop business plans develop revenue generation strategies	business law business management principles company policies corporate social responsibility cost management financial forecasting risk identification strategic planning

Annex 4. Education and training programmes at VET and university levels

Country	University/ school	Programme	Level	Niche
Albania	University of Tirana	Economic Informatics	University education	Digital
Albania	University of Tirana	Informatics	University education	Digital
Albania	University of Tirana	Mathematical and Informatics Engineering	University education	Digital
Albania	University of Tirana	Information and Communication Technology	University education	Digital
Albania	University of Tirana	Biology	University education	Biochemical
Albania	University of Tirana	Biotechnology	University education	Biochemical
Albania	University of Tirana	Chemistry	University education	Biochemical
Albania	University of Tirana	Food Chemistry and Technology	University education	Organic
Albania	University of Tirana	Industrial and Environmental Chemistry	University education	Biochemical
Albania	University of Tirana	Natural Environmental Science	University education	Biochemical
Albania	Polytechnic University of Tirana	Computer Engineering	University education	Digital
Albania	Polytechnic University of Tirana	Telecommunications Engineering	University education	Digital
Albania	Alexander Moisiu Durres University	Practical Informatics	University education	Digital
Albania	Alexander Moisiu Durres University	Practical Informatics	University education	Digital
Albania	Agricultural University of Tirana	Information Systems Management	University education	Digital
Albania	Agricultural University of Tirana	Business informatics	University education	Digital
Albania	Luigj Gurakuqi University, Shkoder	Biology chemistry	University education	Biochemical
Albania	Luigj Gurakuqi University, Shkoder	Computer systems and networks technician	University education	Digital
Albania	Luigj Gurakuqi University, Shkoder	Computing	University education	Digital
Albania	Alexander Xhuvani Elbasan University	Biology chemistry	University education	Biochemical
Albania	Alexander Xhuvani Elbasan University	Business Informatics	University education	Digital
Albania	Alexander Xhuvani Elbasan University	Information Technologies	University education	Digital
Albania	Ismail Qemali University, Vlore	Biology	University education	Biochemical

Albania	Ismail Qemali University, Vlore	Aquaculture and hygiene of fishery products	University education	Organic
Albania	Ismail Qemali University, Vlore	Chemical Laboratory Technician	University education	Biochemical
Albania	Ismail Qemali University, Vlore	Informatics	University education	Digital
Albania	Ismail Qemali University, Vlore	Computer science	University education	Digital
Albania	Ismail Qemali University, Vlore	Information technology	University education	Digital
Albania	Eqerem Cabej Gjirokastr University	Biology chemistry	University education	Biochemical
Albania	Eqerem Cabej Gjirokastr University	Information technology	University education	Digital
Albania	University Fan S. Noli Korçe	Agri-food	University education	Organic
Albania	University Fan S. Noli Korçe	Seed and Seedling Production Techniques	University education	Organic
Albania	University Fan S. Noli Korçe	Biology chemistry	University education	Biochemical
Albania	University Fan S. Noli Korçe	Mathematics Informatics	University education	Digital
Albania	University Fan S. Noli Korçe	Information technology	University education	Digital
Albania	Agricultural University of Tirana	Agri-Food Engineering: Technology of alcoholic and non-alcoholic beverages	University education	Organic
Albania	Agricultural University of Tirana	Agri-food engineering profile: Food Technology	University education	Organic
Albania	Agricultural University of Tirana	Food and Nutrition Science	University education	Organic
Albania	Agricultural University of Tirana	Agrobiology	University education	Organic
Albania	Agricultural University of Tirana	Agricultural Engineering profile: Marine Biology and Aquaculture	University education	Organic
Albania	Agricultural University of Tirana	Agrarian engineering profile: Plant protection	University education	Organic
Albania	Agricultural University of Tirana	Agri-Environmental Engineering	University education	Organic
Albania	Agricultural University of Tirana	Environmental Science profile: Natural Resource Management	University education	Biochemical
Albania	Agricultural University of Tirana	Agricultural Technologist	University education	Organic
Albania	Agricultural University of Tirana	Technologies of Aquaculture and Fishing	University education	Organic
Albania	Western Balkans University	Laboratory Technician	University education	Biochemical

Albania	Western Balkans University	Biotechnology	University education	Biochemical
Albania	Vocational school 'Hamdi Bushati'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Kristo Isak'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Rakip Kryeziu'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Ndre Mjeda'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Isuf Gjata'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Hamdi Bushati'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Hysen Çela'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Kolin Gjoka'	Biotechnology/ Food Technology	Vocational education and training	Organic
Albania	Vocational school 'Rakip Kryeziu'	Veterinary	Vocational education and training	Organic
Albania	Vocational school 'Ndre Mjeda'	Veterinary	Vocational education and training	Organic
Bosnia and Herzegovina	University of Banja Luka	Agriculture and vegetable growing programme	University education	Organic
Bosnia and Herzegovina	University of Banja Luka	Fruit and viticulture specialisation	University education	Organic
Bosnia and Herzegovina	University of Banja Luka	Plant sciences	University education	Organic
Bosnia and Herzegovina	University of East Sarajevo	Agriculture – general	University education	Organic
Bosnia and Herzegovina	University of East Sarajevo	Agriculture – focus on livestock breeding	University education	Organic
Bosnia and Herzegovina	University of East Sarajevo	Agriculture – focus on plant sciences	University education	Organic
Bosnia and Herzegovina	University of East Sarajevo	Agriculture – food chain management	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Economics of Agro-Industry	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Fruit Growing And Viticulture	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Farming and Vegetable Growing	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Food Technologies	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Nutrition	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	Animal Production	University education	Organic

Bosnia and Herzegovina	University of Mostar	Food technology, Plant production and Wine production	University education	Organic
Bosnia and Herzegovina	University of Sarajevo	IT programme in School of Economics and Business	University education	Digital
Bosnia and Herzegovina	University of Sarajevo	IT programmes in Faculty of Electrical Engineering	University education	Digital
Bosnia and Herzegovina	University of Sarajevo	IT programme in Faculty of Traffic and Communications	University education	Digital
Bosnia and Herzegovina	University of Sarajevo	IT programmes in Faculty of Natural Sciences and Mathematics	University education	Digital
Bosnia and Herzegovina	University of Džemal Bijedić Mostar	IT programmes in Faculty of Mechanical Engineering	University education	Digital
Bosnia and Herzegovina	University of Džemal Bijedić Mostar	IT programmes in Faculty of Information Technologies	University education	Digital
Bosnia and Herzegovina	University of Banja Luka	Business Informatics	University education	Digital
Bosnia and Herzegovina	University of East Sarajevo	IT programmes in Faculty Electrical Engineering	University education	Digital
Bosnia and Herzegovina	University of East Sarajevo	IT Programmes in Faculty of Mechanical Engineering, Computing and Electrical Engineering	University education	Digital
Bosnia and Herzegovina	University of East Sarajevo	IT programmes in Faculty of Mechanical Engineering, Computing and Electrical Engineering	University education	Digital
Bosnia and Herzegovina	Public Mixed secondary school, Zenica	Veterinary technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public Mixed secondary school, Zenica	Agricultural technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public Mixed secondary school, Kalesija	Agricultural technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public Mixed secondary school, Kalesija	Food technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public secondary School of Agriculture, Food processing, Veterinary medicine and Service industries, Sarajevo	Food technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public secondary School of Agriculture, Food processing, Veterinary medicine and Service industries, Sarajevo	Milk producer	Vocational education and training	Organic

Bosnia and Herzegovina	Public secondary School of Agriculture, Food processing, Veterinary medicine and Service industries, Sarajevo	Farmer	Vocational education and training	Organic
Bosnia and Herzegovina	Public secondary School of Agriculture, Food processing, Veterinary medicine and Service industries, Sarajevo	Fruit grower – wine grower – winemaker	Vocational education and training	Organic
Bosnia and Herzegovina	Public secondary textile and agriculture school, Mostar	Agricultural technician	Vocational education and training	Organic
Bosnia and Herzegovina	Private VET school Libar, Široki Brijeg	Agricultural technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public agriculture school, Banja Luka	Agricultural technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public agriculture school, Banja Luka	Food technician	Vocational education and training	Organic
Bosnia and Herzegovina	Public agriculture school, Banja Luka	Butcher	Vocational education and training	Organic
Kosovo	University of Prishtina	Fundamentals of Technology	University education	Digital
Kosovo	University of Prishtina	Processing techniques, measurements and automation	University education	Digital
Kosovo	University of Prishtina	Technology of fruit and vegetable, alcoholic and non-alcoholic beverages, milk and milk products	University education	Organic
Kosovo	University of Prishtina	Fermentation technology	University education	Organic
Kosovo	University of Prishtina	Plant Production	University education	Organic
Kosovo	University of Prishtina	Pomology	University education	Organic
Kosovo	University of Prishtina	Viticulture	University education	Organic
Kosovo	University of Prishtina	Information science and communication	University education	Digital
Kosovo	Arkitekt Sinani, Mitrovicë/ Mitrovica	Food Technology	Vocational education and training	Organic
Kosovo	Xheladin Deda, Mitrovicë/ Mitrovica	Food and Diet Assistant	Vocational education and training	Organic
Kosovo	Bahri Haxha, Vushtrri/ Vučitrn	Food Technology	Vocational education and training	Organic
Kosovo	Bahri Haxha, Vushtrri/ Vučitrn	Agribusiness	Vocational education and training	Organic
Kosovo	Bahri Haxha, Vushtrri/ Vučitrn	Horticulture	Vocational education and training	Organic

Kosovo	Bahri Haxha, Vushtrri/ Vučitrn	Arboriculture	Vocational education and training	Organic
Kosovo	Anton Çeta, Skënderaj/ Srbica	Agriculture	Vocational education and training	Organic
Kosovo	Fehmi Agani, Klinë/Klina	Food Technology	Vocational education and training	Organic
Kosovo	Fehmi Agani, Klinë/Klina	Horticulture	Vocational education and training	Organic
Kosovo	Mithat Frashëri, Istog	Livestock	Vocational education and training	Organic
Kosovo	Ali Hadri, Pejë/Peć	Veterinary Technician	Vocational education and training	Organic
Kosovo	Ali Hadri, Pejë/Peć	Horticulture	Vocational education and training	Organic
Kosovo	Ali Hadri, Pejë/Peć	Agricultural Product Technology	Vocational education and training	Organic
Kosovo	12 Maji, Rahovec/ Orahovac	Agriculture	Vocational education and training	Organic
Kosovo	Selajdin Mulla Alia, Rahovec/ Orahovac	Horticulture	Vocational education and training	Organic
Kosovo	Selajdin Mulla Alia, Rahovec/ Orahovac	Food Technology	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Technology of Agricultural	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Production	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Arboriculture - Vineyard	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Processing of Agricultural	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Producers	Vocational education and training	Organic
Kosovo	Kadri Kusari, Gjakovë/ Đakovica	Veterinary Technique	Vocational education and training	Organic
Kosovo	Ymer Prizreni, Prizren	Food Technology	Vocational education and training	Organic
Kosovo	Ymer Prizreni, Prizren	Agribusiness	Vocational education and training	Organic
Kosovo	Abdyl Rama, Shirokë, Therandë/ Shiroka/Suva Reka	Agriculture	Vocational education and training	Organic
Kosovo	Abdyl Rama, Shirokë, Therandë/ Shiroka/Suva Reka	Food Technology	Vocational education and training	Organic

Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Horticulture	Vocational education and training	Organic
Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Ploughing - Vegetable Orchard-Vineyard Agribusiness	Vocational education and training	Organic
Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Food Technology	Vocational education and training	Organic
Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Livestock	Vocational education and training	Organic
Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Plant Protection	Vocational education and training	Organic
Kosovo	Zenel Hajdini, Ferizaj/ Uroševac	Veterinarian	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Food Technology	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Horticulture Arboriculture-Vineyard	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Livestock	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Veterinary	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Meat Processing	Vocational education and training	Organic
Kosovo	Arbëria, Gjilan/ Gnjilane	Fruit Processing	Vocational education and training	Organic
Kosovo	Jonuz Zejnullahu, Viti/ Vitina	Food Technology	Vocational education and training	Organic
Kosovo	Jonuz Zejnullahu, Viti/ Vitina	Horticulture	Vocational education and training	Organic
Kosovo	Adem Gllavica, Lipjan/ Lipljan	Agribusiness	Vocational education and training	Organic
Kosovo	Adem Gllavica, Lipjan/ Lipljan	Horticulture	Vocational education and training	Organic
Kosovo	Adem Gllavica, Lipjan/ Lipljan	Livestock	Vocational education and training	Organic
Kosovo	Isa Boletini, Podujevë/ Podujevo	Agribusiness	Vocational education and training	Organic
Kosovo	Isa Boletini, Podujevë/ Podujevo	Food Processing	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Agribusiness	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Horticulture	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Protection of plants	Vocational education and training	Biochemical

Kosovo	Abdyl Frashëri, Prizren/Prizren	Cultivator of Mixed Cultures and Growing of Animals	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Farmer	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Food processor and related professions	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Fruits and Vegetable Processors	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Dairy Processor	Vocational education and training	Organic
Kosovo	Abdyl Frashëri, Prizren/Prizren	Veterinarians	Vocational education and training	Organic
Kosovo	Gjin Gazulli, Prishtinë/Priština	Informatics	Vocational education and training	Digital
Kosovo	Gjin Gazulli, Prishtinë/Priština	Electrical Installation	Vocational education and training	Digital
Kosovo	Gjin Gazulli, Prishtinë/Priština	Industrial electronics	Vocational education and training	Digital
Kosovo	Don Bosco, Prishtinë/Priština	Information and Communication Technology	Vocational education and training	Digital
Kosovo	Don Bosco, Prishtinë/Priština	Electrical system installer	Vocational education and training	Digital
Kosovo	Fan S Noli, Kryshec, Pejë/ Kruševac, Peć	Computing	Vocational education and training	Digital
Kosovo	Fan S Noli, Kryshec, Pejë/ Kruševac, Peć	Installer Electrical Systems	Vocational education and training	Digital
Kosovo	Ismail Dumoshi, Obiliq/Obilić	Computing	Vocational education and training	Digital
Kosovo	Hivzi Sylejmani, Fushë Kosovë/ Kosovo Polje	Electrical Technician	Vocational education and training	Digital
Kosovo	Hivzi Sylejmani, Fushë Kosovë/ Kosovo Polje	Computing	Vocational education and training	Digital
Kosovo	Adem Gllavica, Lipjan/ Lipljan	Computing	Vocational education and training	Digital
Kosovo	Adem Gllavica, Lipjan/ Lipljan	Electrical Installation	Vocational education and training	Digital
Kosovo	Andrea Durrsaku, Kamenicë/	Computing	Vocational education and training	Digital
Kosovo	Kamenica		Vocational education and training	Digital

Kosovo	Jonuz Zejnullahu, Viti/ Vitina	Computing	Vocational education and training	Digital
Kosovo	Jonuz Zejnullahu, Viti/ Vitina	Industrial Electronics	Vocational education and training	Digital
Kosovo	Jonuz Zejnullahu, Viti/ Vitina	Electrical Installer	Vocational education and training	Digital
Kosovo	Kongresi I Manastirit, Gllamnik, Podujevë/ Glavnik, Podujevo	Computing	Vocational education and training	Digital
Kosovo	Mehmet Isai Gjilan/Gnjilane	Computing	Vocational education and training	Digital
Kosovo	Mehmet Isai Gjilan/Gnjilane	Mechatronics	Vocational education and training	Digital
Kosovo	Mehmet Isai Gjilan/Gnjilane	Electrical Installer	Vocational education and training	Digital
Kosovo	Pjetër Bogdani, Ferizaj/Uroševac	Machinery Operator	Vocational education and training	Organic
Kosovo	Pjetër Bogdani, Ferizaj/Uroševac	Computing	Vocational education and training	Digital
Kosovo	Pjetër Bogdani, Ferizaj/Uroševac	Mechatronics	Vocational education and training	Digital
Kosovo	Pjetër Bogdani, Ferizaj/Uroševac	Electric Installer	Vocational education and training	Digital
Kosovo	Feriz Guri/Vëllezërit Çaka, Kaçanik/Kačanik	Electrics	Vocational education and training	Digital
Kosovo	Feriz Guri/Vëllezërit Çaka, Kaçanik/Kačanik	Computing	Vocational education and training	Digital
Kosovo	11 Marsi, Prizren	IT (Telecomm)	Vocational education and training	Digital
Kosovo	12 Marsi, Prizren	Software Design	Vocational education and training	Digital
Kosovo	13 Marsi, Prizren	Computing	Vocational education and training	Digital
Kosovo	14 Marsi, Prizren	Electrical Installer	Vocational education and training	Digital
Kosovo	Nexhmedin Nixha, Gjakovë/Đakovica	Computing	Vocational education and training	Digital
Kosovo	Nexhmedin Nixha, Gjakovë/Đakovica	Electrics	Vocational education and training	Digital
Kosovo	Selajdin Mulla Alia, Rahovec/Orahovac	Computing	Vocational education and training	Digital
Kosovo	12 Maji, Rahovec/Orahovac	Machinery	Vocational education and training	Organic

Kosovo	Tafil Kasumaj, Deçan/Dečan	Computing	Vocational education and training	Digital
Kosovo	Shaban Spahija, Pejë/Peć	Computing	Vocational education and training	Digital
Kosovo	Shaban Spahija, Pejë/Peć	Electrical Installer	Vocational education and training	Digital
Kosovo	Shaban Spahija, Pejë/Peć	Electric Machines	Vocational education and training	Digital
Kosovo	Mithat Frashëri, Istog	Electrical Installer	Vocational education and training	Digital
Kosovo	Fehmi Agani, Klinë/Klina	Computer Technician	Vocational education and training	Digital
Kosovo	Fehmi Agani, Klinë/Klina	Electrical Installer	Vocational education and training	Digital
Kosovo	COC Skënderaj, Skënderaj/Srbica	Electrical Installer	Vocational education and training	Digital
Kosovo	Anton Çeta, Skënderaj/Srbica	Machinery	Vocational education and training	Organic
Kosovo	Anton Çeta, Skënderaj/Srbica	Electrotechnics	Vocational education and training	Digital
Kosovo	Lutfi Musiqi, Vushtrri/Vučitrn	Computing	Vocational education and training	Digital
Kosovo	Lutfi Musiqi, Vushtrri/Vučitrn	Mechatronics	Vocational education and training	Digital
Kosovo	Lutfi Musiqi, Vushtrri/Vučitrn	Electrical Installation	Vocational education and training	Digital
Kosovo	Arkitekt Sinani, Mitrovicë/Mitrovica	Computing	Vocational education and training	Digital
Kosovo	Fehmi Lladrovci, Drenas/Drenas	Computing	Vocational education and training	Digital
Kosovo	Fehmi Lladrovci, Drenas/Drenas	Mechatronics	Vocational education and training	Digital
Kosovo	BAU Akademi, Prishtinë/Priština	Electrical installation	Vocational education and training	Digital
Montenegro	University Donja Gorica	Technology of products of plant origin	University education	Organic
Montenegro	University Donja Gorica	Technologies in animal production	University education	Organic
Montenegro	University Donja Gorica	Technology of products of animal origin	University education	Organic
Montenegro	University Donja Gorica	Viticulture and winemaking	University education	Organic
Montenegro	University Donja Gorica	Sanitary engineering in the food sector	University education	Organic
Montenegro	University Donja Gorica	Sanitary engineering	University education	Organic

Montenegro	University Donja Gorica	Engineering in the food safety system (HoReCa)	University education	Organic
Montenegro	University Donja Gorica	Urban agriculture	University education	Organic
Montenegro	University Donja Gorica	Economic Informational Systems	University education	Digital
Montenegro	University Donja Gorica	Business Informational Systems	University education	Digital
Montenegro	University Donja Gorica	Informational System Management	University education	Digital
Montenegro	University of Mediterranean	Bachelor in ICT	University education	Digital
Montenegro	University of Mediterranean	Software Engineering	University education	Digital
Montenegro	University of Montenegro	Plant production	University education	Organic
Montenegro	University of Montenegro	Animal husbandry	University education	Organic
Montenegro	University of Montenegro	Continental fruit growing	University education	Organic
Montenegro	University of Montenegro	Mediterranean Fruit production	University education	Organic
Montenegro	University of Montenegro	Technological engineering	University education	Digital
Montenegro	University of Montenegro	Sanitary engineering	University education	Organic
Montenegro	University of Montenegro	Engineering in the HoReCa system	University education	Organic
Montenegro	University of Montenegro	Ecological engineering	University education	Organic
Montenegro	University of Montenegro	Fruit growing, viticulture and oenology	University education	Organic
Montenegro	University of Montenegro	Crop and vegetable farming	University education	Organic
Montenegro	University of Montenegro	Plant protection	University education	Biochemical
Montenegro	University of Montenegro	Continental fruit growing and medicinal plants	University education	Organic
Montenegro	University of Montenegro	Nursery Production	University education	Organic
Montenegro	University of Montenegro	Biology and Ecology	University education	Biochemical
Montenegro	University of Montenegro	Experimental Biology and Bio-technology	University education	Biochemical
Montenegro	University of Montenegro	Environment Protection	University education	Biochemical
Montenegro	University of Montenegro	Biotechnic	University education	Biochemical
Montenegro	University of Montenegro	Electronics, Telecommunications and Computers	University education	Digital
Montenegro	University of Montenegro	Applied Computers Studies	University education	Digital
Montenegro	University of Montenegro	Computers and IT	University education	Digital

Montenegro	Secondary Multidisciplinary School Andrijevica	Production and food processing	Vocational education and training	Organic
Montenegro	Secondary Agricultural School Bar	Agricultural technician	Vocational education and training	Organic
Montenegro	Electro-economics School	Web and mobile apps developer	Vocational education and training	Digital
Montenegro	Secondary Vocational School	Web and mobile apps developer	Vocational education and training	Digital
Montenegro	Secondary Vocational School	Electro-technician for computer systems and networks	Vocational education and training	Digital
Montenegro	Secondary Vocational School	Electro-technician for computer systems	Vocational education and training	Digital
Montenegro	Secondary Vocational School	Informational technologies	Vocational education and training	Digital
Montenegro	Fist Secondary Vocational School Niksic	Agricultural technician	Vocational education and training	Organic
Montenegro	Secondary Vocational School “Mladost”	Web and mobile apps developer	Vocational education and training	Digital
Montenegro	High School for Electro-technical studies “Vaso Aligrudic”	Electro-technician for computer systems and networks	Vocational education and training	Digital
Montenegro	High School for Electro-technical studies “Vaso Aligrudic”	Web and mobile apps developer	Vocational education and training	Digital
Montenegro	High School for Electro-technical studies “Vaso Aligrudic”	Installer of the electro-communicational infrastructure	Vocational education and training	Digital
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Milk processing	Vocational education and training	Organic
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Nurseryman and flower grower	Vocational education and training	Organic
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Fruit and wine production	Vocational education and training	Organic
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Environmental protection technician	Vocational education and training	Biochemical
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Chemical technology technician	Vocational education and training	Biochemical
Montenegro	Secondary Vocational School “Spasoje Rapsopovic”	Chemical laboratory technician	Vocational education and training	Biochemical
North Macedonia	University Goce Delchev	Agriculture	University education	Organic

North Macedonia	University Goce Delchev	Food technology	University education	Organic
North Macedonia	University Ss. Cyril and Methodius	Agriculture programmes	University education	Organic
North Macedonia	University Ss. Cyril and Methodius	IT programmes	University education	Digital
North Macedonia	University St. Kliment Ohridsk	Nutritionism	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Food Technology and Biotechnology	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Quality Management and Food Safety	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Innovative technologies for food and nutrition	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Management in Animal Production	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Food Quality and Safety	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Animal Products Technology	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Agromanagement	University education	Organic
North Macedonia	University St. Kliment Ohridsk	Zootechnics	University education	Organic
North Macedonia	University of Tetova	Food technology	University education	Organic
North Macedonia	University of Tetova	Nutrition	University education	Organic
North Macedonia	University of Tetova	Quality and food safety management	University education	Organic
North Macedonia	The secondary electrical engineering school "Mihajlo Pupin", Skopje	Computer engineering and automation	Vocational education and training	Digital
North Macedonia	The secondary electrical engineering school "Mihajlo Pupin", Skopje	Electronics	Vocational education and training	Digital
North Macedonia	The secondary electrical engineering school "Mihajlo Pupin", Skopje	Telecommunications	Vocational education and training	Digital
North Macedonia	SOZU “Kuzman Shapkarev”, Bitola	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOZU “Kuzman Shapkarev”, Bitola	Technician in agromanagement	Vocational education and training	Organic
North Macedonia	SOZU “Kuzman Shapkarev”, Bitola	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOU “Gotce Delchev”, Valandovo	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOU “Gotce Delchev”, Valandovo	Agrotechnician	Vocational education and training	Organic
North Macedonia	SSOU “Dimitrija Chupovski”, Veles	Baker	Vocational education and training	Organic

North Macedonia	SSOU “Dimitrija Chupovski”, Veles	Meat cutter	Vocational education and training	Organic
North Macedonia	SOU “Vancho Prke”, Vinica	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Metodija Mitevski-Brico”, Delchevo	Food technician	Vocational education and training	Organic
North Macedonia	SU of the City of Skopje “Dimitar Vlahov”, Skopje	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Niko Nestor”, Struga	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Mitko Pendzukliski”, Kratovo	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Gjoce Stojcheski”, Tetovo	Food technician	Vocational education and training	Organic
North Macedonia	SOZSU “Gjorche Petrov”, Kavadarci	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOZSU “Gjorche Petrov”, Kavadarci	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOZSU “Gjorche Petrov”, Kavadarci	Agromanagement	Vocational education and training	Organic
North Macedonia	OSU “Drita”, Kichevo	Baker	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Agrotechnician	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Agromanagement	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Technician in veterinary medicine	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Food technician	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Kiro Burnaz”, Kumanovo	Baker	Vocational education and training	Organic
North Macedonia	DSU and Regional Center for vocational education “Vanco Pitosheski”, Ohrid	Baker	Vocational education and training	Organic

North Macedonia	DSU and Regional Center for vocational education “Vanco Pitosheski”, Ohrid	Meat cutter	Vocational education and training	Organic
North Macedonia	SOU “Orde Chopela”, Prilep	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOU “Orde Chopela”, Prilep	Agromanagement	Vocational education and training	Organic
North Macedonia	SOU “Orde Chopela”, Prilep	Technician in veterinary medicine	Vocational education and training	Organic
North Macedonia	SOU “Orde Chopela”, Prilep	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOU “Orde Chopela”, Prilep	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Tzar Samoil”, Resen	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOU “Tzar Samoil”, Resen	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOU “Kocho Racin”, Sveti Nikole	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOU “Kocho Racin”, Sveti Nikole	Agromanagement	Vocational education and training	Organic
North Macedonia	SUGS “Brakja Miladinovci”, Skopje	Technician in veterinary medicine	Vocational education and training	Organic
North Macedonia	SUGS “Brakja Miladinovci”, Skopje	Agrotechnician	Vocational education and training	Organic
North Macedonia	SUGS “Brakja Miladinovci”, Skopje	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SUGS “Brakja Miladinovci”, Skopje	Technician in agromanagement	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Agrotechnician	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Technician in agromanagement	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Crop producer	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Technician in veterinary medicine	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Food technician	Vocational education and training	Organic
North Macedonia	SOU “Dimitar Vlahov”, Strumica	Baker	Vocational education and training	Organic

North Macedonia	SOSU “Mosha Pijade”, Tetovo	Technician in veterinary medicine	Vocational education and training	Organic
North Macedonia	SOSU “Mosha Pijade”, Tetovo	Technician in phytomedicine	Vocational education and training	Biochemical
North Macedonia	SOSU “Mosha Pijade”, Tetovo	Agrotechnician	Vocational education and training	Organic
Serbia	University of Belgrade	Programmes in agriculture, veterinary and agronomy	University education	Organic
Serbia	University of Novi Sad	Programmes in agriculture, veterinary and agronomy	University education	Organic
Serbia	University of Niš	Programmes in agriculture, veterinary and agronomy	University education	Organic
Serbia	University of Kragujevac	Programmes in agriculture, veterinary and agronomy	University education	Organic
Serbia	University of Belgrade	IT programmes in Faculty of Electrical Engineering	University education	Digital
Serbia	University of Belgrade	IT programmes Faculty of Mechanical Engineering	University education	Digital
Serbia	University of Belgrade	IT programmes Faculty of Technical Sciences	University education	Digital
Serbia	University of Novi Sad	IT programmes in Faculty of Technical Sciences	University education	Digital
Serbia	University of Novi Sad	IT programmes in Faculty of Technical Sciences "Mihajlo Pupin" Zrenjanin	University education	Digital
Serbia	University of Niš	IT programmes in Faculty of Technical Sciences	University education	Digital
Serbia	University of Niš	IT programmes in Faculty of Technical Sciences	University education	Digital
Serbia	University of Kragujevac	IT programmes in Faculty of Technical Sciences	University education	Digital
Serbia	University of Kragujevac	IT programmes in Faculty of Engineering	University education	Digital
Serbia	Union University	IT programmes	University education	Digital
Serbia	Metropolitan University	IT programmes	University education	Digital
Serbia	Singidunum University	IT programmes	University education	Digital
Serbia	International University of Novi Pazar	IT programmes	University education	Digital
Serbia	School of Chemical and Food Technology	Manufacturer of chemical products	Vocational education and training	Biochemical
Serbia	Secondary school of food industry, chemistry and textile industry,	Food technician	Vocational education and training	Organic

Serbia	Agricultural school “Bačka Topola”, Bačka Topola	Operator in the food industry	Vocational education and training	Organic
Serbia	Chemical and technological school, Subotica	Baker	Vocational education and training	Organic
Serbia	Chemical and technological school, Subotica	Food technician	Vocational education and training	Organic
Serbia	Chemical and technological school, Subotica	Winegrower-Winemaker	Vocational education and training	Organic
Serbia	Agriculture and food science secondary school, Sombor	Agro-mechanical technician	Vocational education and training	Organic
Serbia	Secondary vocational school, Kula	Food technician	Vocational education and training	Organic
Serbia	Agricultural school “Vršac”, Vršac	Operator in the food industry	Vocational education and training	Organic
Serbia	Agricultural school “Vršac”, Vršac	Agrotechnician	Vocational education and training	Organic
Serbia	Agricultural school “Vršac”, Vršac	Food technician	Vocational education and training	Organic
Serbia	Agricultural school “Vršac”, Vršac	Agro-mechanical technician	Vocational education and training	Organic
Serbia	Technical secondary school “23 Maj”, Pančevo	Food technician	Vocational education and training	Organic
Serbia	Technical secondary school “Pavle Savić”, Novi Sad	Baker	Vocational education and training	Organic
Serbia	Secondary school of food science, forestry, and chemistry, Sremska Mitrovica	Butcher	Vocational education and training	Organic
Serbia	Agricultural and chemical secondary school, Belrgade	Baker	Vocational education and training	Organic
Serbia	Agricultural secondary school “PKB”, Belgrade	Baker	Vocational education and training	Organic
Serbia	Agricultural secondary school “PKB”, Belgrade	Butcher	Vocational education and training	Organic

Serbia	Agricultural school “Sonja Marinković”	Food technician	Vocational education and training	Organic
Serbia	Požarevac		Vocational education and training	Organic
Serbia	Agricultural school “Ljubo Mićić”, Požega	Butcher	Vocational education and training	Organic
Serbia	Agricultural school “Ljubo Mićić”, Požega	Agrotechnician	Vocational education and training	Organic
Serbia	Agricultural school “Ljubo Mićić”, Požega	Food technician	Vocational education and training	Organic
Serbia	Agricultural school with a student dormitory, Valjevo	Butcher	Vocational education and training	Organic
Serbia	OVC “Braća Nedić”, Osečina	Food technician	Vocational education and training	Organic
Serbia	Secondary school “Sveti Sava”, Loznica	Operator in the food industry	Vocational education and training	Organic
Serbia	Secondary school “Sveti Trifun”, Aleksandrovac	Winegrower-Winemaker	Vocational education and training	Organic
Serbia	Agricultural and chemical school “Dr Djordje Radić”, Kraljevo	Baker	Vocational education and training	Organic
Serbia	Secondary school “Svetozar Krstić Toza”, Leskovac	Baker	Vocational education and training	Organic
Serbia	Secondary school “Svetozar Krstić Toza”, Leskovac	Operator in the food industry	Vocational education and training	Organic
Serbia	Agricultural school with a student dormitory “Rajko Bosnić”, Negotin	Winegrower-Winemaker	Vocational education and training	Organic
Serbia	Agricultural and veterinary school “Stevan Sindjelić, Vranje	Food technician	Vocational education and training	Organic
Serbia	Agricultural and veterinary school “Stevan Sindjelić, Vranje	Agrotechnician	Vocational education and training	Organic
Serbia	Agricultural school “Radoš Jovanović Selja”, Prokuplje	Agrotechnician	Vocational education and training	Organic
Serbia	Food and chemical school, Niš	Baker	Vocational education and training	Organic
Serbia	Food and chemical school, Niš	Butcher	Vocational education and training	Organic

Serbia	School of Electrical Engineering “Nikola Tesla”, Belgrade	Electrical technician for information technology	Vocational education and training	Digital
Serbia	Machine school "Radoje Dakic", Belgrade	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Secondary school for new technologies "Polytechnic", Belgrade	Computer-Aided Design (CAD) Mechanical Technician	Vocational education and training	Digital
Serbia	Secondary school for new technologies "Polytechnic", Belgrade	Mechatronics technician	Vocational education and training	Digital
Serbia	Technical school, Pančevo	Mechatronics technician	Vocational education and training	Digital
Serbia	Vocational school, Kragujevac	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Secondary school “Djura Jaksic”, Rača	Electrical technician for information technology	Vocational education and training	Digital
Serbia	Technical-agricultural school with a student dormitory, Sjenica	Electrical technician for information technology	Vocational education and training	Digital
Serbia	Technical school, Valjevo	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Technical school, Valjevo	Mechatronics technician	Vocational education and training	Digital
Serbia	Technical school, Vranje	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Secondary School of Machines and Traffic, Čačak	Mechatronics technician	Vocational education and training	Digital
Serbia	Secondary School of Machines and Traffic, Čačak	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Secondary School "Nikola Tesla", Boljevac	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Technical school, Trstenik	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Technical school, Tutin	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Technical school, Zrenjanin	Computer Numerical Control (CNC) machine technician	Vocational education and training	Digital
Serbia	Technical school, Zrenjanin	Mechatronics technician	Vocational education and training	Digital

Serbia	Technical school, Vlasotince	Mechatronics technician	Vocational education and training	Digital
Serbia	Vocational school, Svilajnac	Mechatronics technician	Vocational education and training	Digital