TECHNOLOGICAL CHANGES AND SKILLS NEEDS IN THE AGRI FOOD SECTOR IN SERBIA: DIGITALISATION FOR AGRI-FOOD

SUMMARY REPORT

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INTRODUCTION

This summary report[1] forms part of a broader study on the technological changes and skills needs of the Western Balkan agri-food sector, conducted by the European Training Foundation (ETF). The aim of this summary report is to examine the potential of digitalisation for agri-food in Serbia from the perspective of skills supply and demand.

The study aims to inform a foresight exercise on technological changes and skills needs in the digitalisation for agri-food sector of Serbia. The purpose of the foresight exercise is to identify concrete skills related measures to support the accelerated development of the sector in preparation for the single market.

OVERVIEW

Across the globe, information and communication technologies applied to the agri-food sector have improved productivity and supply chains, cut costs, and improved the quality of agricultural products. The speed of technology adoption is correlated with farmers ability to purchase and operate new technologies. The sector workforce presents a low skill level in comparison with the digital solutions available and the opportunities they offer to boost competitiveness in a sustainable way. Yet, the digital transformation in agri-food value chains is far from over. This puts pressure on farmers, agri-businesses, extension services, and policymakers to upskill and reskill the agri-food workforce – and to tailor it to fit specific local contexts.

In Serbia, innovative SMEs continue to emerge and thrive, bolstering the agri-food sector with new ideas and fresh perspectives. It is SMEs that are driving the shift to using more digital tools and other advanced technologies in the sector.

In recent years, the digital transformation of agriculture can be seen through the development of precision agriculture and the inclusion of remote sensing, robots, farm management information systems, and decision support systems in the everyday functioning of the agri-food sector. From artificial intelligence and robotics to the Internet of Things and 5G, the latest technologies can offer invaluable support for SMEs, both for producers and users, and across the agri-food value chain.

E-commerce in the agri-food sector is promising and may help direct sales and shorten supply chains. It has gained momentum, particularly in the aftermath of the COVID-19 pandemic.

SME support services, however, have not kept up with the pace, and more needs to be done in terms of SME training support and technology adoption and transfer. Similarly, career development support to attract skilled professionals to the agri-food sector is lagging behind. Digitalisation is changing the sector and new, attractive occupations and interesting job profiles are emerging, in particular at the cross-section of agri-food with other sectors, for both young people and experienced professionals.

[1] This report was prepared by Pirita Vuorinen, ETF. The contents of this summary report are the sole responsibility of the ETF and do not necessarily reflect the views of the EU institutions.

The analysis of the niche of digitalisation for agri-food focuses on businesses developing and producing digital innovations for agri-food under the following NACE sectors:

- 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 service activities (J63);
- Research and experimental development on natural sciences and engineering (M72.1).

The table below presents the main administrative indicators of Serbian companies operating in these sectors.

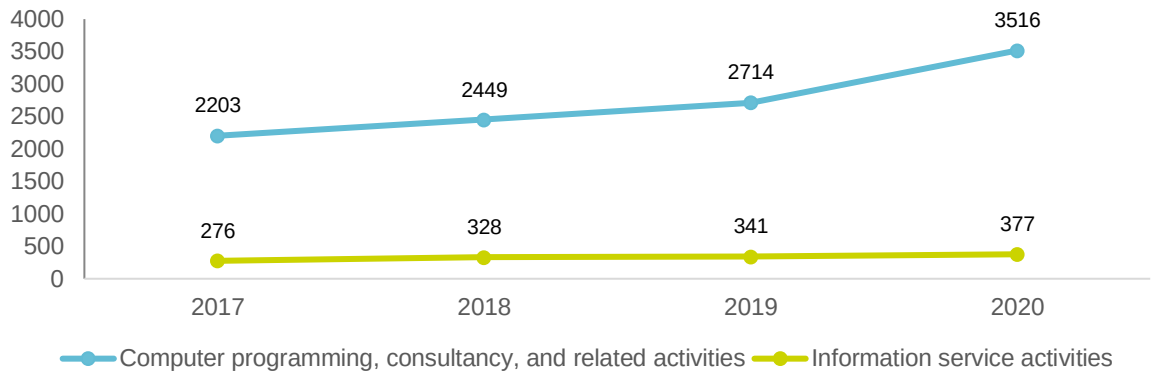
TABLE 1: ADMINISTRATIVE DATA ON THE NUMBER OF COMPANIES, GROSS VALUE ADDED, TURNOVER AND EMPLOYEES – DIGITALISATION FOR AGRICULTURE AND FOOD PROCESSING

Year	Number of employees	Turnover per employee (EUR thousands)	Gross value added per employee– (EUR thousands)	Number of companies
C28.3 Manufacture of agricultural and forestry machinery				
2017	1 018	47.6	11.8	86
2018	1 080	49.9	11.8	90
2019	1 016	51.3	12.7	88
2020	1 025	51.4	13.1	85
C28.9 Manufacture of other special-purpose machinery				
2017	2 422	42	12	198
2018	2 582	46.2	14.2	207
2019	2 611	46.4	14.6	203
2020	2 614	44.3	12.4	209
J62 Computer programming, consultancy and related activities				
2017	19 854	45.5	24.1	2 203
2018	22 112	51.5	25.5	2 449
2019	24 730	59.2	27.4	2 714
2020	35 615	48.8	28.9	3 516
J63 Information service activities				
2017	1 947	52.3	14.7	276
2018	2 336	73.5	16	328
2019	2 849	74.6	17.2	341
2020	3 847	27.1	16.7	377
M72.1 Research and experimental development on natural sciences and engineering				
2017	7 349	37.5	18.1	311
2018	6 393	46.3	22.2	304
2019	6 415	51	24.4	320
2020	6 710	49.9	26	335

- Source: Eurostat (2022). Industry by employment size class (NACE Rev. 2, B-E).

According to the NACE classification, ICT companies are mainly registered in two sectors: computer programming, consultancy and related activities (J62) and information service activities (J63). These two sectors combined employ approximately 40 000 people. Most companies are small and employ an average of 10 people.

FIGURE 1: ICT SECTOR: THE GROWING NUMBER OF SMES IN ICT



Source: Eurostat (2022). Industry by employment size class (NACE Rev. 2, B-E).

Research and experimental development on natural sciences and engineering (M72.1) plays an important role in digitalisation for agriculture and food processing. In 2020, 335 companies operated in this sector, employing 6 710 people.

In 2022, 95% of companies in the manufacture of agricultural and forestry machinery (C28.3) and all companies in the manufacture of machinery for food, beverage and tobacco processing (C28.9)[2] were SMEs, of which approximately 70% and 80% respectively were micro-enterprises. Neither sector had any large enterprises with over 250 employees.

Average monthly salaries in sectors developing and producing digital innovations for the agri-food sector are generally higher than the national average. In 2021, the average wage in computer programming, consultancy and related activities (J62) was nearly three times the national average.

Skills demand

Most in-demand profiles that companies are looking for have tertiary education in fields related to engineering, computer science, software development and agriculture. Based on the ISCO/ESCO classification, these occupations can be mainly classified in the ISCO groups 2 (professionals) and 3 (technician and associate professionals).

The companies interviewed emphasised the need for profiles combining specialist digital skills with agri-food sector-specific knowledge. Such occupational profiles and skills, at the intersection of ICT and agriculture, are not yet described in the ESCO skills and occupations database.

TABLE 2: RELEVANT TECHNICAL OCCUPATIONS IDENTIFIED BY COMPANIES

Digital technologies

[2] As noted earlier, due to the lack of data for sector C28.9.3, we analysed the data for this sector at level 2, i.e. the data for sector C28.9 – Manufacture of machinery for other purposes.

• Mechatronics engineer (2144.1.11) • Software and applications developers and analysts (251), e.g. embedded systems software developer (2514.2.1), mobile application developer (2514.2.2)	• Technicians (ISCO group 3), e.g. mechatronics engineer technician (3115.1.11) • Robotics engineering technician (3119.2.1) • Sensor engineering technician (3114.1.10)
Agronomy, agriculture and food processing	
• Agronomist (2132.2)	• Food technologist (2145.1.4)

Source: evidence from interviews and ESCO classification of skills, competences and occupations.

The occupations for which there is a growing demand require different skill levels. For instance, mechatronics engineers, robotics engineering technicians, sensor engineering technicians, embedded systems software developers and mobile application developers require at least ISCED level 5. The highest level of qualification is required for agronomists and food technologists (ISCED level 6) and mechatronics engineers (ISCED level 7).

In terms of business services and related occupations, company interviews reveal the importance of market development skills. To remain competitive and scale up locally, regionally and internationally, companies highlighted the need for sales managers and assistants to expand into foreign markets. At the same time, more traditional sales skills such as door-to-door sales representatives are still much needed. Management at the SMEs interviewed also highlighted the need for soft skills such as communication, marketing, sales and English language.

TABLE 3: RELEVANT BUSINESS SUPPORT OCCUPATIONS IDENTIFIED BY COMPANIES

Business support occupations	
• Sales manager (1221.3.2.1) • Marketing manager (1221.3.2) • Digital marketing manager (1221.5) • Marketing consultant (2431.10)	• Technical sales representative in agricultural machinery and equipment (2433.6.1) • Sales assistant (5223.4) • Marketing assistant (2431.10.3)

Source: evidence from interviews.

Companies find new hires through both personal recommendations and employment websites such as Infostud. Experts from academia and from specialist consulting companies are usually hired on short-term contracts.

The feedback received from the interviews with companies is that companies do dedicate resources to training (e.g. participation in seminars and conferences) and professional development of their employees (e.g. team-building workshops, informal and non-formal training). Individual learning (e.g. online) is also promoted and supported.

Skills supply

Vocational education and training

As new skills needs emerge, different from those traditionally sought by the agri-food sector, the shift needs to be reflected in an increase in training provision across the occupational profiles of the value chains – and not just for IT occupations.

There are four VET providers offering training programmes in agri-food, and 19 offering ICT-related programmes. The feedback received from interviews with companies is that VET providers have not

moved as quickly in terms of technology, curricula, teaching methods and connections with the labour market as would have been needed to keep up with the pace of development. According to the interviewees, VET does not offer the occupational profiles or training that companies are actively seeking.

BioSense Research and Development Institute for IT in biosystems, founded in 2015, is a leader in Serbia and the western Balkans in promoting the adoption of state-of-the-art digital solutions to the farming sector. BioSense also works with education and training providers to develop agri-food education models. A joint project with a secondary agriculture school in the city of Futog consisted of equipping the school with the necessary technology, e.g. laptops, video projectors and printers, and a digital platform, AgroSense. The project has enabled teachers and students to collect and manipulate meteorological data on precipitation, air and soil temperature, humidity, wind, etc., and use it for precision agriculture tools.[3]

Engagement between education and training institutions and companies to design and deliver adequate training programmes and to foster the development of the agri-food sector is critical. However, the interviews with companies pointed to minimal cooperation between agri-food VET providers and companies. Skills needs in agri-food may differ between regions and even within regions. Local and regional skills ecosystem stakeholders are the best placed to understand how global trends affect local supply and demand for technology and skills, and how to leverage the power of partnerships. The interviews revealed a missed opportunity for agri-food VET providers to work with local agri-food and digital companies on the challenges of digitalisation and emerging skills and technology needs. Were agri-food VET providers to be equipped with new technology, they could deliver training to agribusinesses and accelerate technology adoption. The newly formed (2022) Government Office for VET aims to enhance cooperation between businesses and schools as part of the Smart Specialisation Strategy.

Intermediary organisations

The ambition to meet the challenges of competitiveness, digitalisation and sustainability poses many challenges to agri-food companies, most of which are micro- or small enterprises. Business intermediary bodies are critical for providing access to relevant and timely informal and non-formal training to agri-food companies, which generally consider having the relevant skills to perform far more important than training recognition. Intermediary organisations have an important role in creating value in a fragmented context, by connecting agri-food companies with stakeholders and networks with which they can collaborate, co-create, troubleshoot or co-innovate. Their role is particularly heightened in agri-food, where agriculture, digitalisation and technological development converge.

Non-formal education and training programmes are offered by various institutions, including agricultural schools, agricultural extension services, and private training providers. There are several types of providers of non-formal education in the agri-food sector in Serbia.

Agricultural schools in Serbia often provide vocational training programmes, short-term courses, and workshops in various aspects of the agri-food sector.

[3] Serbian Society for Informatics (2023), *Higher Schools of Information and Communication Technology (ICT)*. Retrieved from https://dis.org.rs/it-zanimanje/visoke-skole-za-ikt/.

Agricultural advisory and professional service (AAPS) under the auspices of the Ministry of Agriculture, Forestry and Water Management is one of the key supporting services to farmers in Serbia in terms of knowledge transfer. Expert and advisory services advisors are available to agricultural producers in around 450,000 farms in order to improve agricultural production. The AAPS system includes a total of 34 services throughout the country. The AAPS is one of the most important channels for providing training to famers, including organic producers. However, the advisers also need tailor-made training to advance their skills, particularly in the digital sphere. The Programme Committee assess the needs and defines the training curricula for advisors with the aim to ensure knowledge transfer to farmers. In order to keep their license, the AAPS advisers have to undergo regular training.

The Serbian Chamber of Commerce and Industry (PKS) provides training and counselling services to businesses in the agri-food sector.

The Serbian Association of Agricultural Economists and Agribusiness Professionals (SAEAP) offers training, networking opportunities, and information resources to its members.

Development Agency of Serbia (RAS)[4] with 16 regional offices is a government organisation offering a wide range of services including support to direct investments, competitiveness, and export promotion, leading the implementation of projects aiming to improve Serbia's attractiveness and reputation and increase economic and regional development. It supports micro, small and medium enterprises, and entrepreneurs, as well as domestic and foreign investors seeking to set up or expand their business in Serbia, RAS strives to raise Serbia`s position in the region and globally.

According to interviewees there are also few private training providers which offer non-formal education programmes in the agri-food sector such as agrokursevi.rs and different associations of producers (Serbia Does Apples, Serbia Organica, LAG, etc).

[4] RAS has 16 accredited regional development agencies (ARPA) in its network, as follows: in Belgrade, Novi Sad, Subotica, Zrenjanin, Pančevo, Ruma, Požarevac, Loznica, Kragujevac, Zaječar, Užice, Kraljevo, Kruševac, Niš, Novi Pazar and Leskovac.

BOX 1. EXAMPLES OF INTERMEDIARY ORGANISATIONS' SUPPORT

The Agricultural Advisory and professional Service of Serbia's (PSSS) main role is to work on improving and developing agricultural production. It is one the most important channels for addressing farmers' real needs and providing training, counselling and assistance on introducing and expanding the use of new knowledge and technology transfer in agri-food. The PSSS also disseminates information about IPARD (Pre-accession assistance – Agriculture and rural development) and provides technical support for aspiring beneficiaries.

In 2018, **BioSense** launched the first digital farm in Serbia, which provides stakeholders with hands-on learning opportunities and showcases how AgTech solutions can be implemented in real-world settings. The virtual part of the farm – the AgroSense digital platform – enables farmers and extension services to monitor crops for free and to plan activities using computers and mobile phones, based on the data collected from satellite images, drones, robots, various sensors, and meteorological stations. The fact that there are more than 15 000 registered users is an indicator of successful digital transformation.

The **Vojvodina ICT Cluster** (VOICT) is a business association founded in 2010 through a bottom-up initiative of ICT companies and several supporting institutions. To build the capacity and competitiveness of its members, VOICT has established a Cluster Academy, through which it organises courses, presentations and lectures. The Academy cooperates with the University of Novi Sad and its Faculty of Technical Sciences. VOICT has also established a project office and teamed up with the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) to build an internal service and competence unit to support applications under various EU instruments for both members and non-members.

There are approximately 150 licensed drone pilots who, according to the law, can also operate drones for agricultural purposes. **The Drone Pilot Serbia Association** is the first association of drone pilots in Serbia. It has been liaising with companies in this niche, but also with the Chambers of Commerce and with BioSense Institute in providing support in various fields, such as sampling and determining soil quality, troubleshooting with irrigation and pests, etc. It provides training to other yet-to-be drone pilots in this niche.

From the interviews, it emerged that a number of intermediary organisations, from large institutions to non-governmental organisations, act as catalysts for digitalisation for agri-food and seek to create value to companies in the sector. Their support in informal and non-formal training, networking, coaching and guidance is invaluable. With collaboration and co-creation at the core of innovation and competitiveness, there is still untapped potential for intermediary organisations to make connections across converging sectors at national, regional and EU levels.

Higher education and research

Universities play a fundamental role in fostering digital transformation in the agri-food sector. They have a role in not only teaching, but also in researching the agri-food sector. Their research departments play a key role in innovation.

They are four university poles in Serbia: Belgrade, Novi Sad, Niš, and Kragujevac – where eight universities provide higher education relevant for digitalisation in agri-food. In the field of technical sciences, over 10 faculties offer higher education, while there are three main universities in the field of ICT. However, none of the faculties offer interdisciplinary programmes, for example combining agriculture and digital skills such as machine learning, AI, digital twinning or 3D.

Universities must continuously reinvent themselves to better support the sector's transformation. This puts pressure on them to work hand in hand with the ecosystem to enable science, technology and innovation to drive and guide the agri-food sector's transformation. Interviews suggest that university-company cooperation does take place, e.g. related to the calibration, measurement and certification of products.