TECHNOLOGICAL CHANGES AND SKILLS NEEDS IN THE AGRI FOOD SECTOR OF BOSNIA HERZEGOVINA: DIGITALISATION FOR AGRI-FOOD

SUMMARY REPORT

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INTRODUCTION

This 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). This aim of this report is to examine the potential of the agri-food sector of Bosnia and Herzegovina from the perspective of the skills demand and supply in the following three niches of agri-food value chain: digitalisation in agriculture and food processing, biochemical and microbial products for agriculture, and organic foods.

The study aims to inform further steps at the national and regional level in supporting the innovation ecosystems, VET, higher education and skills development, as well as lifelong career guidance systems and thus contribute to successful implementation of Smart Specialisation Strategy in the agri-food sector in Bosnia and Herzegovina.

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.

Digitalisation for agri-food is at a very initial stage in Bosnia and Herzegovina and the economy has yet to reap the benefits of digitalisation. The small size of agricultural holdings, low productivity of the agri-food sector, and poorly developed governance framework amplify the need for accelerated modernisation of the sector.

The use of digital technologies in the agri-food sector in Bosnia and Herzegovina mostly refers to the use of web technologies in the context of communication (e.g., e-mail). Modernisation and digitalisation in the sector is often equated with the process of mechanisation of agricultural production, automation of certain processes and the acquisition of digital equipment.

The analysis of niche of digitalisation in agri-food focuses on the businesses developing and producing the 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);

[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.

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

Although ICT sector in the economy is growing, the study did not identify companies that develop or produce innovative digital solutions specifically for agri-food.

TABLE 1. ACTIVE ENTERPRISES AND ENTREPRENEURS IN THE ICT SECTOR (NACE REV. 2)

	As of 31st December 2021.		
	Total	**Active enterprises that submitted financial reports for 2021**	**Active entrepreneurs in 2021**
J INFORMATION AND COMMUNICATION	2,678	1,482	1,196
58 Publishing activities	183	146	37
59 Motion picture, video and television programme production, sound recording and music publishing activities	104	82	22
60 Programming and broadcasting activities	159	157	2
61 Telecommunications	94	90	4
62 Computer programming, consultancy and related activities	1,836	858	978
63 Information service activities	302	149	153

Source: BiH Agency of Statistics (2022). p. 7. Available here.

However, several agri-food companies that have begun their digital transformation journey were identified e.g. in production of microgreens indoors by incorporating elements of vertical agriculture, or e-commerce on organic and functional foods.

Development of digital skills is one of the key aspects of digital transformation in the agri-food sector. Agri-food is an important sector and more than 500,000 smallholder-owned farms and about a third of the population is in some way engaged in agriculture.[2] The percentage of the employed with basic digital skills in Bosnia and Herzegovina is below the Western Balkans average. While the regional figures of basic digital literacy ranged from 30% to 45% in 2021, only 25% of the employed in Bosnia and Herzegovina had basic digital skills.[3]

Strong domestic demand is seen as a precondition for companies developing digital solutions for agri-food to grow. The e-commerce market in Bosnia and Herzegovina is still underdeveloped. According to UNCTAD's e-commerce index, the economy is ranked 70th out of 152 countries.[4] Although 76.5% of medium[5] and 57.8% of small companies[6] have their own web pages, and 16.4% of medium and 6.1% of small companies use cloud services,[7] businesses are still reluctant to embrace e-commerce. Moreover, only half of the population over the age of 15 has a bank account and only 15.5% of the population have made purchases or paid bills online. There are similar trends across the Western

[2] IFAD. Bosnia and Herzegovina. Available here.
[3] OECD (2021). Competitviness in South East Europe 2021: A Policy Outlook. Available here.
[4] UNCTAD (2020). technical Notes on ICT for Development. Available here.
[5] Agency for Statistics BiH (2021).Upotreba informaciono - komunikacionih tehnologija u BiH. Available here.
[6] Agency for Statistics BiH (2021).Upotreba informaciono - komunikacionih tehnologija u BiH. Available here.
[7] Agency for Statistics BiH (2021).Upotreba informaciono - komunikacionih tehnologija u BiH. Available here.

Balkans region. Namely, according to the latest Balkan Barometer report[8], 38% companies in the region made less than 5% of their total revenues through online channels.

In 2021, with the support of the FAO, a Framework for the economy's future e-agriculture strategy was developed.[9] The framework defines five key priorities for developing e-agriculture in the economy, which include accelerating the digital transformation of the public sector, the practical application of ICT at the farm level, the development of digital knowledge and skills at the institutional and individual levels, the improvement of digital infrastructure in rural areas, and raising awareness of the benefits of using ICT solutions in agriculture.

In 2022, average monthly salaries in Computer programming, consultancy and related activities at (EUR 1.109) were significantly higher than the national average.

Skills demand

Most in-demand profiles in Bosnia and Herzegovina are those related to blockchain technology, smart sensors, drones, an automated irrigation systems. Based on ESCO classification, a number of occupations include these skills and competences in their profiles:

- agricultural equipment design engineer (ESCO 2144.1.2.1)
- mechatronics engineer (2144.1.11)
- photonics engineer (2149.12.1)
- electronics engineer (2152.1)
- embedded systems security engineer (2529.3)
- 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)
- remote sensing technician (3111.13)
- sensor engineering technician (3114.1.10)
- electronic equipment assembler (8212.3)

Interviewees indicated the need for both basic and advanced digital skills in precision farming which requires combining data analytics, sensors, remote imaging and GPS technology to optimise yields and reduce waste (e.g., ESCO 2144.1.18). Other important skills relate to developing and maintaining apps and software aimed at optimising processes (ESCO 2512.4), as well as promoting climate smart agriculture practices farm management (ESCO 2133.7).Such profiles are currently difficult for companies to find in the labour market and a solution to address skills gaps of employees are sought through long-term partnerships and networks.

[8] Balkan Barometer (2022). Infographics. Available here.
[9] UN (November 2021). Bosnia and Herzegovina prepares for digital transformation in agriculture with support of FAO. Available here.

In terms of business services and related occupations, company interviews reveal the importance of administration, sales, marketing, and human resource management related skills.

TABLE 2. RELEVANT BUSINESS SUPPORT OCCUPATIONS IDENTIFIED BY COMPANIES

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 agricultural machinery and equipment (2433.6.1)
• advertising specialist (2431.3)	• technical sales representative in electronic and telecommunications equipment (2434.4)
• marketing consultant (2431.10)	• wholesale merchant in agricultural machinery and equipment (3324.4.1)
• market research analyst (2431.11)	
Business and project management	
• business manager (1213.5)	• project manager (1219.6)
• farm manager (6130.1)	• accountant (2411.1)
• industrial quality manager (1321.2.2)	• ICT quality assurance manager (2519.5)
• quality engineer (2149.2.7)	
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)
Human resources management	
• human resources manager (ESCO 1212.2)	• human resources assistant (4416.1)

Skills supply

Vocational education and training

As new skills needs are emerging, different from the ones 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 at least 44 initial vocational education and training (IVET) and technical schools in Bosnia and Herzegovina which offer training for ICT-related occupations.[10] In addition, there are at least 20 schools that offer ICT technician as a qualification at ISCED level 3 in 2019.[11] However, there is no VET provision in areas where agriculture, digitalisation and technological development are converging.

[10] See here. The information was not provided by national institutions, so there may be more schools and IT programmes.
[11] ETF: DIGITAL SKILLS AND ONLINE LEARNING IN BOSNIA AND HERZEGOVINA: DIGITAL FACTSHEET DECEMBER 2019. Available here.

The skills that students gain through vocational are very broad and theoretical, due to the lack of emphasis on experiential learning[12] and practical experience.

The use of advanced digital and technological solutions in the agri-food sector requires workers to develop new knowledge and skills. Interviews reveal that continuing vocational education (CVET) helps to at least partially offset the limitations found in IVET and higher education.

TABLE 3. CVET PROGRAMMES IN AGRI-FOOD SECTOR ACROSS BIH

CVET programme	CVET provider	Mode of ownership	Formal/non-formal
Agriculture and food processing (Agricultural technician, Food technician)	Public Mixed secondary school, Zenica	Public	Formal
Agriculture and food processing	Eduka BIH Center of adult education	Private, located in Tesanj and Sarajevo	Formal and non- formal (retraining and professional training)
Agriculture and food processing	Center for adult education	Private, located in Tuzla	Formal and non-formal
Agriculture and food processing, butcher	Center for adult education "Hartmann & Mayer"	Private, located in Brcko District	Formal and non-formal

The career guidance system in Bosnia and Herzegovina is weak and the majority of initiatives to reform the education system have been initiated by the international organisations and NGOs.

Higher education and research

Universities play a fundamental role in fostering digital transformation of the agri-food sector. They have a role in teaching but also in researching the agri-food sector. Their research departments play a key role in innovation.

There were 25 universities that offer ICT programmes and seven public universities that offer programmes related to agriculture. However, in Bosnia and Herzegovina there is currently no relevant higher education provision addressing the emerging professions in the area where agri-food systems are converging with and transformed by digitalisation and technological development.

Most higher education programmes are tailored generally for agriculture, food technology, agro-economics, or zoology. There are more specific study programmes related to fruit growing and viticulture as well as nutrition and animal production. The skills that students gain through higher education are very broad and theoretical, due to the lack of emphasis on experiential learning.[13]

The ability of companies in Bosnia and Herzegovina to harness their growth potential through the adoption of new technologies and digital transition is hindered by lack of relevant skills.

[12] Kundalić A., Zulejhić E., Mahmić S., Džaferbegović A., Alibegović N., Sokolović A., Šabić -Hamidović Dž. (2018) Istraživanje o realizaciji praktične nastave u srednjim školama u BiH, Asocijacija srednjoškolaca u Bosni i Hercegovini

[13] Kundalić A., Zulejhić E., Mahmić S., Džaferbegović A., Alibegović N., Sokolović A., Šabić -Hamidović Dž. (2018) Istraživanje o realizaciji praktične nastave u srednjim školama u BiH, Asocijacija srednjoškolaca u Bosni i Hercegovini

Agriculture as a study field is decreasing in popularity across higher education programmes. In 2022 the established quotes enabled the enrolment of 477 students in the first year of agricultural studies but only 66 candidates enrolled[14].

Interviewed universities stated that they did not cooperate with other stakeholders, including other education and training providers, enterprises, business associations, and chambers of commerce, to help the stakeholder ecosystem adapt to the changing skills demand in the agri-food sector. According to the interviewees, there was also a lack of trust and collaboration among all ecosystem stakeholders in developing the skills offer.

Intermediary organisations

The ambition to meet the challenges of competitiveness, digitalisation and sustainability, poses many challenges to the primarily micro and small agri-food companies. Business intermediary bodies are critical for providing access to relevant and timely informal and non-formal training to agri-food companies who generally find having 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 actors and networks with whom they can collaborate, co-create, troubleshoot, or co-innovate with. Their role is particularly heightened in agri-food where agriculture, digitalisation and technological development are converging.

There are no specialised intermediary bodies for that focus specifically on digitalisation for agri-food. In addition, support for skills development usually comes as part of the general support for agriculture.

BOX 1. EXAMPLES OF INTERMEDIARY ORGANISATIONS' SUPPORT

Smart Village Knežica, an agricultural cooperative established in 2014, helps agricultural producers adopt digital technologies to boost competitiveness. The Smart Village employs 20 researchers in the fields of agriculture, economics, and programming. Although mainly a hub that promotes R&D collaboration between researchers, experts, practitioners, and agricultural producers to increase competitiveness, the Smart Village does have a component relevant to technology development. Under an ongoing Horizon 2020 funded project, SmartAgriHubs, the Smart Village has developed services for digital food quality and traceability using blockchain technologies.[1] The Smart Village primarily focuses on experimentation and development, rather than commercialisation, of digital solutions for agri-food. The aim of the cooperative is to become a "creative oasis," where R&D and agriculture meet.[1]

BitAlliance is an important ICT business intermediary in BiH. They are an association of the largest IT companies active in the country.[1] Their activities focus on cooperation with academic community to change the ICT educational curricula at all levels of education and make them more responsive to labour markets. In addition, they cooperate with the government to facilitate the adoption of relevant strategies for ICT industry in BiH. Finally, they also work with member companies to develop the sector.

[14]Agroklub portal. Available here.

There are numerous international projects in Bosnia and Herzegovina that help fill gaps regarding digitalisation and agri-food. The EU4Business project (2018-2022) aimed at strengthening SMEs in BiH, including those in the agriculture. The goal of the project was to support the modernisation in agri-food in BiH funds and supporting cross-sectoral cooperation initiatives.

The European Bank for Reconstruction and Development (EBRD), the European Union (EU) and the and Germany's Gesellschaft für Internationale Zusammenarbeit (GIZ) launched a 'Go Digital in Bosnia and Herzegovina' programme in 2022 to help SMEs better understand the opportunities offered by digitalisation and benefit from investing in it.

EU4AGRI is a four-year (2020-2024) project of the European Union, funded under the Instrument for Pre-Accession Assistance (IPA), implemented and co-funded jointly by United Nations Development Programme (UNDP) and Czech Development Agency (CzDA). The project aims to help modernise the agri-food sector and create new jobs in Bosnia and Herzegovina. It focuses on increasing the skills level of agricultural producers and other participants in the value chains through trainings, workshops, and provision of mentoring and advisory services.

From the interviews it emerged that a number of intermediary organisations and donor projects 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 level.