ETF Working together Learning for life

European Training Foundation

THE EU AGENCY SUPPORTING COUNTRIES TO DEVELOP THROUGH LEARNING

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

SUMMARY REPORT

CONTENTS

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 North Macedonia 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 in North Macedonia. 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 North Macedonia, 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. Digitisation is changing the

[1] This report was prepared by Pirita Vuorinen, ETF.

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.

The analysis of the niche of digitisation 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 North Macedonian companies operating in these sectors.

TABLE 1. ADMINISTRATIVE DATA ON THE NUMBER OF COMPANIES, TURNOVER AND EMPLOYEES – DIGITAL

Year	Number of employees	Income in MKD	Income in EUR (exchange rate 61.5)	Number of companies
M72.1 Research and experimental development on natural sciences and engineering				
2019	209	346 075 000	5.6 million	51
2020	190	308 885 000	5 million	54
2021	183	351 104 000	5.7 million	53
J63 Information service activities				
2019	1 742	2 746 194 000	44.6 million	345
2020	1 895	2 993 961 000	48.7 million	377
2021	2 854	4 306 128 000	70 million	405
J62 Computer programming, consultancy and related activities				
2019	7 888	15 116 107 844	245.8 million	1 311
2020	8 801	17 729 417 485	288.3 million	1 429
2021	10 273	22 377 103 304	363.9 million	1 635
C28.3 Manufacture of agricultural and forestry machinery				
2019	92	75 392 510	1.2 million	8
2020	97	98 314 694	1.6 million	7
2021	95	91 241 894	1.5 million	10
C28.9.3 Manufacture of machinery for food, beverage and tobacco processing				
2019	138	233 794 328	3.8 million	15
2020	132	238 619 476	3.9 million	15
2021	137	295 297 954	4.8 million	16

Source: Central Registry of the Republic of North Macedonia.

In 2020, there were 1 957 economically active ICT companies in North Macedonia, of which over 56% were in the 'Software and IT Services' subsegment and 27% in 'ICT Trade and Manufacturing'. In total, ICT companies had 15 093 employees with an average of 7.46 employees per company[2].

Data from the Central Registry shows that between 2019 and 2021, the 'Computer programming, consultancy and related activities' (J62) and 'Information service activities' (J63) subsectors experienced fast growth, both in terms of the number of new companies created and the turnover. Most of the income of these companies is from abroad, through outsourcing services and, to a lesser extent, from the domestic market.

SKILLS DEMAND

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

The companies interviewed were not looking for new employees at the time of the interviews. Most interviewees stated that the energy crisis had constrained investments and recruitment in the sector and the impact of this would be felt throughout 2023. Based on the profiles of current employees and the products and services that the companies offer, a number of ESCO occupations could be identified as relevant for the niche, as presented in the table below.

BOX 1: TECHNICAL OCCUPATIONS RELEVANT FOR DIGITISATION FOR AGRI-FOOD, BASED ON COMPANIES' SKILLS NEEDS

Digital technologies	
• Software developers (2512) • Agricultural equipment design engineer (2144.1.2.1) • Mechatronics engineer (2144.1.11)	• Mechatronics engineering technician (3115.1.11) • Mechatronics assembler (8211.3) • Electronic equipment assembler (8212.3) • Electronics engineer (2152.1)
Agronomy, agriculture and food processing	
• Agricultural scientist (2132.1) • Agronomist (2132.2)	• Agricultural technician (3142.1)

Besides the skills needed to develop digital solutions for agriculture, the interviewees noted that the use of advanced digital and technological solutions in the agri-food sector requires workers to develop new knowledge and skills. Another barrier for technology adoption is the cost. Due to the small size of farms, new cooperation mechanisms or models are needed to make it easier for farmers to share equipment and tools to help cut the cost of technology adoption. The areas where skills shortages were observed by the companies interviewed can be summarised as follows:

- **Data analysis and management**: Applying tools like spreadsheets and specialist software (electronic diaries, calendars and similar) to collect, analyse and manage data related to farming operations, such as soil analysis, crop yields and irrigation schedules. Introducing digital solutions and upskilling farmers would replace the use of paper-based diaries, which is common among

[2] PowerPoint Presentation (masit.org.mk)

North Macedonian farmers, whose farming operations such as soiling, applying pesticides and others are entered in digital calendars on a tablet.

- **Precision agriculture**: Applying technology like GPS and sensors to gather data on soil conditions, weather patterns and crop growth, and using this data to optimise farming practices, such as applying fertilisers and pesticides more efficiently. These skills would boost productivity in the farming operations. During the field interviews, there was a common concern that farmers are using their mobile applications for weather forecasting and are making decisions on whether there is a need to apply pesticides or fertilisers in a given period. Hence, their estimations are based on experience and consultations with farmer peers, rather than using precise sensory data on atmospheric conditions, soil conditions and parameters that can optimise the processes.
- **Drone technologies**: Operating drones equipped with cameras and sensors to gather data on crops, soil and other characteristics of farming operations. This data can be used to make better and decisions about irrigation, fertilisation, pest control, harvesting and farming operations.
- **Online marketing and e-commerce**: Using the internet and e-commerce services to market and sell agricultural products to consumers, or through online marketplaces. During the period of pandemic in 2020 and 2021, the agricultural sector was affected disproportionally compared to other sectors in terms of company closures. While many companies in the retail, wholesale, pharmacy and HoReCa sectors used the advantage of modern digital solutions, such as online sales and deliveries to customers, agricultural companies and farmers scarcely used online sales channels and e-commerce. Hence, it is important to modernise and revive the agri-food market by using technological solutions such as e-commerce and supply chains.
- **Crop monitoring and prediction**: Using data analysis and machine learning techniques to predict crop yields and optimise farming practices based on weather patterns and other factors that can affect the growing processes.

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.

Digital profiles are usually prepared by technical vocational schools in electrical engineering and similar fields. For instance, the secondary electrical engineering school ‘Mihajlo Pupin’ in Skopje offers programmes in computer engineering and automation, as well as in electronics and telecommunications.[3] Agriculture profiles are prepared by e.g. the VET school Brakja Miladinovci in Skopje and the RVETC ‘Kiro Burnaz’ in Kumanovo. According to feedback received from the VET institutions interviewed, public funding to acquire modern equipment is insufficient to ensure relevant training provision for digitisation in agri-food. To keep up with the pace of new digital technologies, interviews with VET schools pointed to the need to provide continuous teacher training and to equip schools with the relevant technology for teachers to pass the skills on to their students. They do have

[3] See, for example, here.

experience disseminating information about modern technologies to VET institutions through an Erasmus project.

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 the cooperation being rather ad hoc. For example, companies may provide training to VET schools on the use of drones, software for high-precision aerial 3D maps, robots for applying pesticides and similar modern technological solutions to high school students. However, the use of such technologies and digital tools has not been integrated into the standard curriculum, and therefore remain ad hoc.

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 digitisation and emerging skills and technology needs. Were agri-food VET providers to be equipped with new technology, they could deliver training not only to their students, but also to agribusinesses, accelerating technology adoption.

Intermediary organisations

The ambition to meet the challenges of competitiveness, digitisation 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, digitisation and technological development converge.

BOX 2: EXAMPLES OF INTERMEDIARY ORGANISATIONS' SUPPORT

The Chamber of Commerce for ICT (MASIT) is an ICT association that promotes and represents enterprises active in the ICT sector in North Macedonia. In 2019, MASIT launched the second cycle pre-qualification project. The project carried out pre-qualification training for interested candidates for ICT occupational profiles. The sample of candidates was made up of unemployed people not older than 35 who wished to gain knowledge and practical skills in IT with a view of being employed by ICT companies. The programme developed by the project lasted for 3 months.[1]

The Fund for Innovation and Technological Development (FITD) is a public institution that aims to improve access to financial support to promote innovation and technological development in North Macedonia. The majority of the FITD's financial support (51%) is used to support start-ups, mostly founded by young people. Examples of training and consultations the FITD provides to potential applicants include identifying and formulating technology readiness levels, technology benchmarking, identifying the innovative potential of a company and/or a proposed idea, and competition analysis.

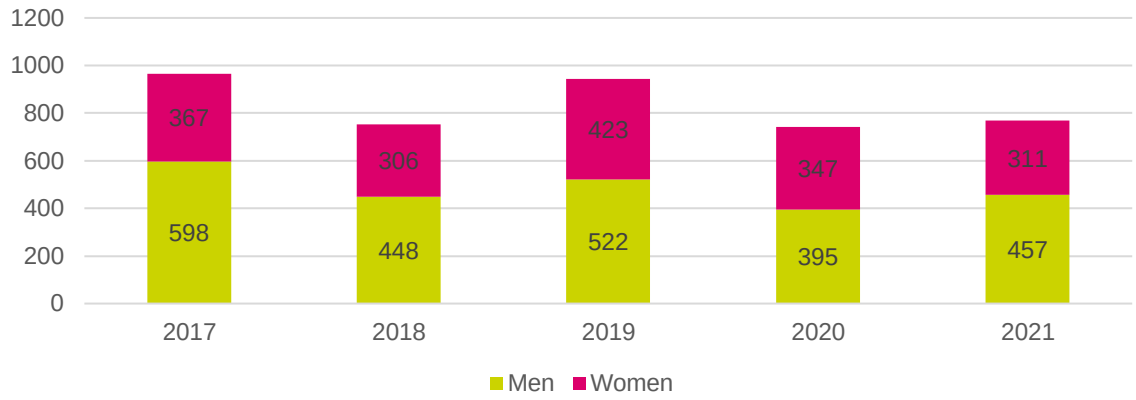
When it comes to in-company training, the companies interviewed used different models. Companies training their staff in-house were more experienced and senior employees transferred knowledge to new employees; this process usually lasted between 3 and 6 months. Other companies relied on online courses and subscriptions offered by training providers. This was especially common for staff working in software engineering and programming businesses.

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.

The number of university graduates in computer science, ICT and engineering offered at 15 faculties in the country has varied through the years. In 2021, around 8% of all students graduated from these faculties. As shown in the figure below, men represent almost two thirds of graduates.

FIGURE 1: NUMBER OF GRADUATES FROM FACULTIES OF COMPUTER SCIENCE, ENGINEERING AND ICT, BY SEX[4]



Source: State Statistical Office Makstat, own representation.

Electronics, software engineering and informatics faculties in the country have more advanced training offers in terms of digital training curricula, such as artificial intelligence, machine learning, IoT, programming/coding and the design of digital tools. However, there is little evidence that the training converges with the agri-food sector. Agricultural faculties, in turn, include digital skills in their curricula but rely on mandatory practical training to build the relevant skills.

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 is mainly based on commercial terms, where universities or research labs provide services to the companies related to the calibration, measurement and certification of their products. Cooperation with the scientific and research centres is occasional and project-based, where most funds come from donor funds, such as Horizon 2020, Erasmus+ and similar programmes.

[4] The faculties involved are: Faculty of Information and Communication Technologies (UKLO), Faculty of Electrical Engineering and Information Technologies (UKIM), Faculty of Computer Science and Engineering (UKIM), Faculty of Electrical Engineering (UGD), Faculty of Computer Sciences (UGD), Faculty of Computer Science and Engineering (UIST), Faculty of Communication Networks and Security (UIST), Faculty of Applied Information Technology, Mechanical Intelligence and Robotics (UIST), Faculty of Information Sciences (MTU), Faculty of Informatics (European University), Faculty of Informatics (FON), Faculty of Computer Science and IT (UACS), Faculty of Contemporary Sciences and Technologies (SEE), Faculty of Computer Science (UTM), Faculty of Informatics (ISU).