

# SMARTLABOR

Strengthening Alliances for Policy Development and Testing in the domain of Innovation, Digitalization, and the Labour Market in the Western Balkans

## Mapping and Analysis of Education and Training Capacities for the Agri-Food Sector in North Macedonia



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## LIST OF ACRONYMS

AEC	Adult Education Center
CEFTA	Central European Free Trade Area
CSO	Civil Society Organizations
ESA	Employment Service Agency
EU	European Union
FDI	Foreign Direct Investments
FIDT	Fund for Innovation and Technological Development
GDP	Gross Domestic Product
ISCO	International Standard Classification of Occupations
ESCO	European Skills, Competences, Qualifications and Occupations
LFS	Labour Force Survey
MAFWE	Ministry of agriculture, forestry and water economy
MSPDY	Ministry of Social Policy, Demographics and Youth
MoEL	Ministry of Economy and Labour
MoES	Ministry of Education and Science
NACE	Nomenclature of Economic Activities
NEA	National Extension Agency
NQF	National Qualification Framework
OCU	Open Civic Universities
SME	Small and Medium Sized Enterprises
SNA	Skills Needs Analysis
SSO	State Statistical Office
S3	Smart Specialization Strategy
UNESCO	United Nations Educational, Scientific and Cultural Organization
VET	Vocational Education and Training

## **EXECUTIVE SUMMARY**

Despite improvements over the past decade, North Macedonia's labour market indicators remain less favourable compared to the EU average. Low activity rates and high unemployment, particularly among women, youth, and the Roma population, highlight ongoing challenges. Additionally, migration and demographic trends are exacerbating these issues, with global factors such as rapid digitalization, technological advancements, changing consumer preferences, and global trade relations further impacting the sector.

The current labour force shows significant mismatches, relying heavily on traditional knowledge and limited modern agricultural practices. Key findings reveal substantial gaps between the education system's output and the labour market needs in the agri-food sector. Formal education often fails to address the specific requirements of modern agriculture, while non-formal education providers offer flexible, skills-oriented training but face challenges in accessibility and modernized curricula.

Secondary vocational education and training (VET) schools, universities, research institutes, and non-formal education centres collectively contribute to workforce training. However, there is a notable gap in integrating digital elements across curricula and training programs. While VET schools and non-formal educational centres provide practical skills for immediate job readiness, their focus on modern technologies such as digital agriculture, precision farming, and climate-smart practices remains limited and requires additional training. Similarly, higher education and research institutions emphasize theoretical and specialized knowledge but need stronger alignment with emerging digital trends and modern practices.

Incorporating digital tools and methodologies into education is vital for developing a competitive agri-food workforce in North Macedonia. Analysing ESCO classifications can help fill these gaps by integrating digital skills and modern technologies into training programs.

## 1. INTRODUCTION

The agri-food sector in North Macedonia is a vital component of the national economy, contributing significantly to GDP and employment. However, the sector faces several challenges, including skills mismatches, low levels of digitalization, and a declining workforce.

The current labour force in the agri-food sector relies heavily on traditional knowledge and limited modern agricultural practices. Formal education often fails to address the specific requirements of modern agriculture, while non-formal education providers offer flexible, skills-oriented training but face challenges in accessibility and modernized curricula.

This study focuses on mapping and analysing the capacities and practices of education and training providers in North Macedonia to address skills gaps in the agri-food sector. By assessing the skills supply, the study evaluates the ability of formal and non-formal training providers to meet labour market demands, particularly in addressing emerging challenges such as digitalization. This approach provides valuable insights into the strengths and gaps within the current system, emphasizing the role of education and training in supporting workforce development in the agri-food sector.

The study aims to assist employers in defining workforce requirements and fostering collaboration with education providers to enhance readiness, while supporting education institutions in aligning curricula with labour market demands. The findings also inform evidence-based policies to address skills mismatches, promoting sustainable development, economic growth, and alignment with European integration priorities.

## 2. OVERVIEW OF AGRIFOOD SECTOR

Based on the latest macroeconomic data, country's GDP in 2024 was 15.5 billion euros<sup>1</sup> or around 8,600 euros per capita, ranking it among the upper-middle-income economies according World Bank classification. Although there were positive indicators of economic growth at 2.1% in 2023, and 2.2% in 2024, the growth outlook for 2025 remains uncertain due to various domestic and global challenges affecting the economy.

As a small and open economy, the country faces various vulnerabilities and uncertainties due to global events. In this regard, Macedonian economy registered unusually high annual inflation rates of 14.2% in 2022 and 9.4% in 2023, primarily due to rising consumer prices for agricultural products and transportation. High inflation rates and global uncertainties prompted policymakers to increase the budget for the Ministry of Agriculture, Forestry, and Water Economy (MAFWE) in order to provide increased support for domestic agricultural production.

The agricultural sector is among the most significant sectors in Macedonian economy, both in terms of GDP share and exports. In 2023, national statistics calculated that the sector employs

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<sup>1</sup> Preliminary data for 2024, [Ministry of Finance of the Republic of North Macedonia](#).

about 7.8% of country's workforce<sup>2</sup> and adds nearly 6.6 % to the economy's GDP<sup>3</sup>. The trends from the beginning of the 1990s until mid-2010s show that on average around 16%-18% of all employees were employed in the sector<sup>4</sup>, however, starting from 2015, statistical data shows that the number of employees in the sector is decreasing. For example, in 2014, Labour Force Survey (LFS) data estimated that nearly 127,000 or 18.6% of all employees were employed in the sector, while in 2023, revised numbers shows that nearly 54,000 were employed in agriculture, forestry and fishery sector, or nearly 7.8 % of all employees<sup>5</sup>.

**Active companies in agriculture:** The number of active businesses entities whose main activity is Agriculture, forestry and fishing was 2,287 in 2022, which constituted 3.2% of all active businesses (2022 was the last year with available data in this field) <sup>6</sup>. The sector features high number of small businesses (around 89% of active businesses employ up to 9 employees) of which significant share are among the rural population, hence playing important role in providing income and means of subsistence for those living in rural areas.

The overall number of all active companies in 2022 decreased by 6% compared to pre pandemic 2019, while agriculture sector recorded 12% decrease of active business compared to pre-pandemic period (for more information see Table 1, below). All these indicators shows that the sector has become less attractive for doing business, investments and job creation.

**Table 1: Main indicators of agriculture sector**

indicator	measurement/ year	2019	2020	2021	2022	2023
<b>Gross Domestic Product</b>						
Agriculture, forestry and fishing	% share of GDP	8.1	8.6	7.1	7.4*	7.0*
<b>Employment</b>						
Total employed in MK**	LFS persons	711,082	703,733	693,494	692,034	688,296
Employed in Agriculture	LFS persons	91,434	91,150	81,819	69,143	53,746
Employment in Agriculture	% share of all employees	13	13	12	10	8
<b>Active businesses</b>						
Active business entities NACE Rev. 2 ***	Number	2,605	2,414	2,342	2,287	N.A.

<sup>2</sup> <http://makstat.stat.gov.mk> , accessed on: 19 January 2025

<sup>3</sup> <http://makstat.stat.gov.mk/>, preliminary data for 2023

<sup>4</sup> [Statistical yearbook](#) of State Statistical Office (various editions)

<sup>5</sup> [Labour Force Survey of the State Statistical Office](#)

<sup>6</sup> <http://makstat.stat.gov.mk/> , accessed on 3 December 2024

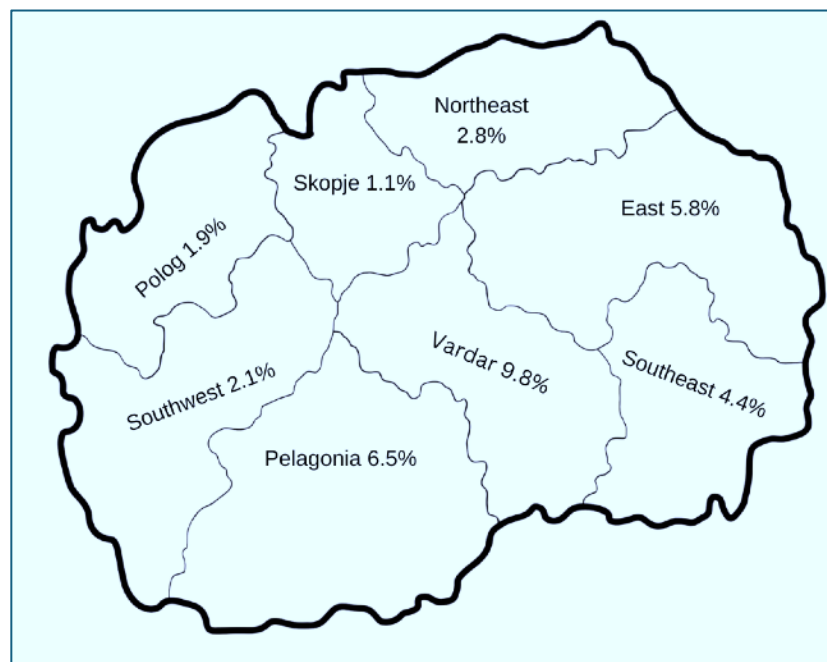
\* preliminary and estimated respectively  
\*\* Labour Force Survey from State Statistical Office  
\*\*\* Makstat

Source: Makstat, author's calculations

**Regional distribution of companies:** Further, the number of business entities varies on regional level. For example, southern parts of the country which constitutes the Vardar, Pelagonija, East and Southeast region, have higher percent of active businesses registered in Agriculture, forestry and fishing. Vardar region is leading in this comparison, with almost 10% of the business registered in agriculture, or 522 out of 5,212.

The map below also shows that only small number of registered businesses are registered in agriculture in Skopje and Polog regions, whose number was between 1-2% out of total businesses in 2022.

**Map 1: Share of active enterprises working in Agriculture, forestry and fishing out of total enterprises, regional (2022)**



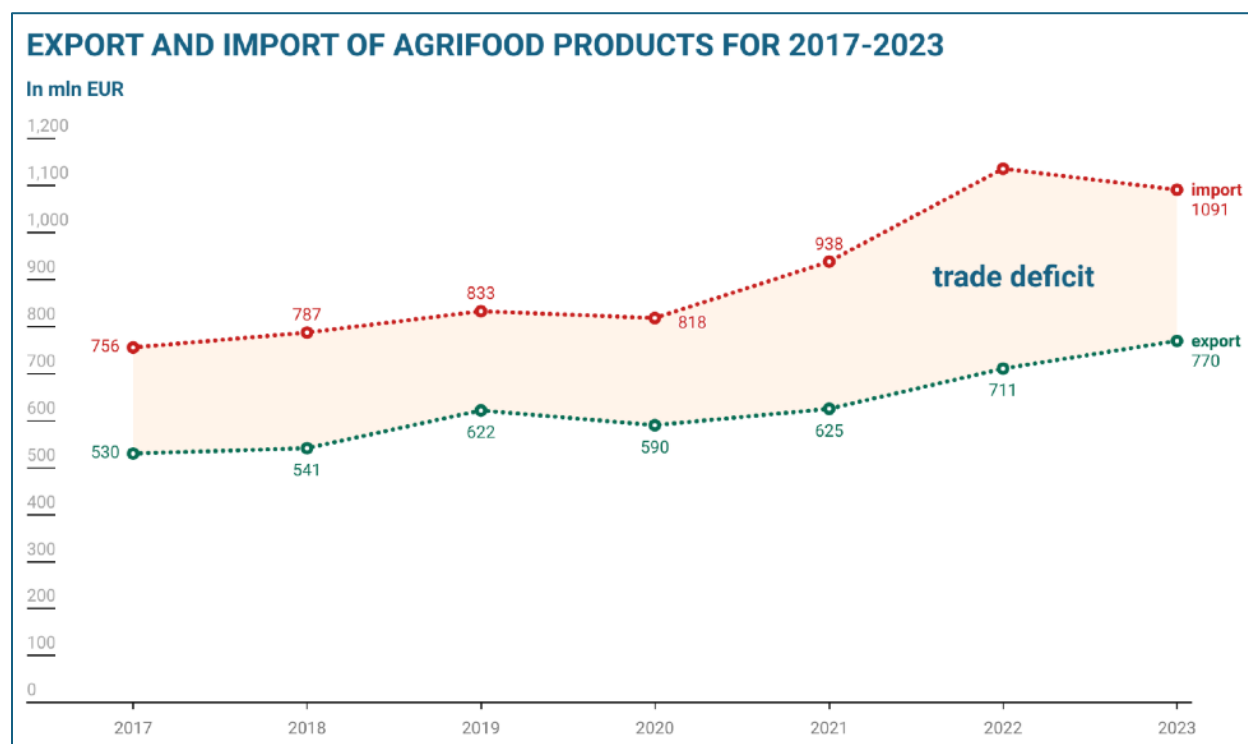
Source: Makstat, own representation

**The international trade** statistics are part of various national strategies and policy documents in the country. International trade dynamics provide not only the status of trade balance, but also measures the competitiveness of domestic goods and services on international markets. Agri-food sector takes significant part of the country's international trade share, of about 10% in



2017, and agri-trade statistics provide useful information on the trends and dynamics of the sector and its subgroups to policymakers.

From 2017 to 2023, both export and import values of agri-food products increased, with a slight decline occurring in 2020 during the pandemic. Macedonian export of agri-food products reached 770 million euro in 2023, or about 9% of total exports of goods, and the importation reached 1.09 billion euro or 9.8% of all imports of goods, thus registering about 320 million euro of trade deficit. The annual trade statistics for the agri-food sector from 2017 to 2023, as shown in the graph below, indicate an increasing trend in trade deficits over the years. The trade deficit increased from 225 million euros in 2017, to 320 million euros in 2023.



Source: Makstat, own representation

European Union (EU-27) countries are the largest trade bloc for agri-food products with which trades North Macedonia. Statistics from the [Eurostat](#) shows that in 2023, about 943 million euro or about 49% out of 1.9-billion euro agri-food trade volume were traded with the EU countries, mainly Germany, Greece, Italy, Bulgaria, Croatia and Poland.

Western Balkan countries<sup>8</sup> also part of [CEFTA](#)<sup>9</sup> trade bloc, constitute the second biggest trade market for agri-food products. The country being part of CEFTA, has been in continuation expanding its trade volume in agri-food sector, reaching 630 million euro (33% of all agri-food

<sup>7</sup> For the trade statistics in year 2021, preliminary data from the State Statistical Office is used

<sup>8</sup> Albania, Bosnia and Herzegovina, Montenegro, Kosovo and Serbia

<sup>9</sup> Central European Free Trade Agreement

trade). Serbia is the country's main trade partner for agri-food products, with approximately 370 million euro agri-food trade volume in 2023.

**Wages in Agriculture sector:** data on wages are published by the SSO<sup>10</sup> and represented as average paid net wage, by NACE rev.2 sector. The statistics on wages are published only as averages across sectors on NACE Rev.2 on two digits level, without having wages published by other disaggregation, such as median, age groups, regions/municipalities and gender. The overall average wage increased by approximately 35%, while the agriculture sector saw a growth of about 33% in the period 2020-2023. The IT sector outpaced both, with a growth rate nearing 39%.

Despite the agricultural sector's growth, its wages remain significantly lower than those in the IT sector, which were more than three times higher in 2023. This underscores the substantial wage disparity between the IT industry and agriculture sector, highlighting the rewarding nature of careers in computer programming and consultancy, compared to sectors that are more traditional.

**Table 2: Average net wage in the country with selected sectors**

year	2020	2021	2022	2023
Average wage in the country in MKD (euro*)	27,182 (442)	28,718 (466)	31,859 (518)	36,614 (595)
Agriculture, forestry and fishing (A)	21,747 (353)	22,837 (371)	25,436 (413)	28,948 (470)
Computer programming, consultancy and related activities (J62)	66,993 (1,089)	73,378 (1,193)	82,437 (1,340)	92,871 (1,510)

Source: Makstat, own calculations,  
\*for euro exchange rate is 61.5MKD to 1 euro

### 3. RESEARCH OBJECTIVES AND METHODOLOGY

The combined findings from the desk research and analysis, mapping of the educational providers and discussions with the focus group representatives provide insights into the key challenges and achievements in education and skills development for the agri-food sector in North Macedonia. These insights offer a clearer understanding of the sector's current landscape and the potential pathways for improvement.

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<sup>10</sup> The data is collected from administrative sources Public Revenue Office and Employment Service Agency.

## Research Objectives

This research aims to analyse the educational capacities for adequate supply of skills in the agri-food labour market of North Macedonia and provide recommendations on how to bridge the digital skills mismatch. The Research methods include a) desk research, b) mapping of educational offer, and c) data collection through focus groups interviews with stakeholders from the academia, education, business, CSOs, and policymaker.

### Key research questions include:

- What are the emerging digital skills requirements in the agri-food sector of North Macedonia?
- What are the key factors contributing to the mismatch between the digital skills demanded by employers and the skills supplied by educational institutions in the agri-food sector?

Methodology included desk research, focus groups discussions, and mapping of stakeholders. The process took place from June to December 2024.

## 4. RESULTS

### 4.1. Desk Research

Desk research resulted with little literature on the topic digital skills in agriculture in North Macedonia. The most important policy document that addresses digitalisation of the agri-food sector in the country is the Strategy for Agricultural and Rural Development 2021-2027, where precision agriculture, education and training for agricultural workers, decrease of administrative burden with use of digital solutions are among the topics and approaches elaborated on how to tackle in the envisaged period of implementation of the Strategy.

Among the weaknesses mentioned in the Strategy are the low level of digitalisation in the sector, low educational attainment of the agricultural workers, weak awareness of the agricultural workers about the digitalisation, aging and emigration of the rural population, large part of small farms and individual farmers which do not have financial capacities to introduce and use modern technology and tools.

Another strategic document is the Smart Specialisation Strategy of the Republic of North Macedonia 2024-2027 which aims to foster green and sustainable growth by embedding knowledge, innovation, and technology to create high value-added products and services competitive in both international and domestic markets. The strategy focuses on four vertical priority domains:

- Smart Agriculture and Food with Higher Added Value
- Information and Communication Technologies (ICT)
- Electro-Mechanical Industry – Industry 4.0

- Sustainable Materials and Smart Buildings

Developed through a detailed analytical and consultative process, the S3 strategy emphasizes the need for digital skills in the agri-food sector to enhance productivity, efficiency and competitiveness. Currently, the S3 Strategy is accompanied by biannual action plan 2024-2025.

#### 4.1.1. Skill Needs Analysis

Skills Needs Analysis (SNA) is a report prepared annually by the Employment Service Agency (ESA) and serves as one of the fundamental documents for preparing the Operational Plan for Active Employment Programs and Measures and Services on the labour market<sup>11</sup>. Latest SNA was prepared for 2024 and assess the skills and occupations needs in the upcoming 6-12 months disaggregated by region and ISCO classification.

The SNA in combination with other sources, such as local labour market projections, surveys conducted by the employer’s organisations and chambers of commerce, serves as underpinning document for assessment and plan for the trainings demanded on the labour market.

In the latest SNA, employers in the agriculture sector who have seven or more employees reported a need for 362 workers for the year 2024, including 231 workers with elementary education. When looking at the occupations in demand, the following profiles were required:

**Table 3: Occupations demanded in agri-food sector (Skills Need Analysis for 2024)**

ISCO code	Name
2132	Farming, Forestry and Fisheries Advisers
3116	Chemical Engineering Technicians
6112	Tree and Shrub Crop Growers
6114	Mixed Crop Growers
7513	Dairy Products Makers
7514	Fruit, Vegetable and Related Preservers
8341	Mobile Farm and Forestry Plant Operators
9211	Crop Farm Labourers
9212	Livestock Farm Labourers
9216	Fishery and Aquaculture Labourers

Source: Employment Service Agency, own representation

<sup>11</sup> Source: Employment Service Agency, accessed on 10 December 2024

#### 4.1.2. Using ESCO to identify digital skills needed in the agri-food sector

The ESCO<sup>12</sup> (European Skills, Competences, Qualifications and Occupations) classification supports labour matchmaking by offering a standardized framework that helps job seekers and employers communicate more effectively. By categorizing and describing skills, competences, qualifications, and occupations in a consistent manner, ESCO enables job seekers to present their abilities clearly and employers to specify their requirements accurately. This reduces mismatches and improves the efficiency of the hiring process.

For training providers, ESCO offers several benefits. It helps them align their curricula with the needs of the labour market by providing detailed descriptions of the skills and competences required for various occupations. This ensures that training programs are relevant and up to date, enhancing the employability of graduates.

In the ESCO classification, currently 1,201 skills and knowledge concepts are labelled as **digital** and are further described and connected to occupations. This includes: 718 skills, 475 knowledge concepts and 7 transversal skills.

In our analysis, with the use of software for analysing big data we cross referenced the occupations needed from the Skills Needs Analysis in agri-food sector, and matched with the occupations and digital skills and knowledge concepts as referenced in the [ESCO database v.1.2.0](#). The results of the matching process are shown below:

**Table 4: Cross referenced occupations related to agri-food sector ISCO/ESCO**

ISCO code	Name-Skills Needs Analysis	ESCO Concept description	ESCO Preferred skill label
2132	Farming, Forestry and Fisheries Advisers	Analyse and interpret survey data acquired from a wide variety of sources e.g. satellite surveys, aerial photography and laser measurement systems.	process collected survey data /**
		Application of computers, computer networks and other information technologies and equipment to storing, retrieving, transmitting and manipulating data, in the context of a business or enterprise.	use IT tools
		Be familiar with blended learning tools by combining traditional face-to-face and online learning, using digital tools, online technologies, and e-learning methods.	apply blended learning

<sup>12</sup> [European Skills, Competences, Qualifications and Occupations](#)

Be familiar with Open Publication strategies, with the use of information technology to support research, and with the development and management of CRIS (current research information systems) and institutional repositories. Provide licensing and copyright advice, use bibliometric indicators, and measure and report research impact.	manage open publications /***
Efficiently operate common communication systems used in emergencies, such as base station mobile transmitters and receivers, portable transmitters and receivers, repeaters, cellular phones, pagers, automated vehicle locators, and satellite phones as required.	operate an emergency communication system
Efficiently use milk testing software and interpret the results correctly.	use milk control software *
Operate communication devices in order to interact with customers, colleagues, and others.	use communication devices
Operate Open Source software, knowing the main Open Source models, licensing schemes, and the coding practices commonly adopted in the production of Open Source software.	operate open source software */**
Produce and analyse scientific data originating from qualitative and quantitative research methods. Store and maintain the data in research databases. Support the re-use of scientific data and be familiar with open data management principles.	manage research data **
Produce, describe, store, preserve and (re) use scientific data based on FAIR (Findable, Accessible, Interoperable, and Reusable) principles, making data as open as possible, and as closed as necessary.	manage findable accessible interoperable and reusable data **
The design and application of innovative ICT solutions in agriculture, horticulture, viticulture, fishery, forestry and livestock management.	e-agriculture */**
The functioning of computer controlled systems that provide animal feeding.	computerised feeding systems *

	The tools involved in geographical mapping and positioning, such as GPS (global positioning systems), GIS (geographical information systems), and RS (remote sensing).	geographic information systems *
	Use relevant information systems and databases to plan, manage and operate agricultural enterprise and production.	use agricultural information systems and databases */**
	Using modern technologies and equipment with high precision positioning systems, geo-mapping and/or automated steering systems for agricultural activities.	apply precision farming *

\* Sector-specific skill, otherwise cross-sectoral

\*\* Essential, otherwise optional skill

The result from the table above shows that occupations related to ISCO unit group 2132-Farming, Forestry and Fisheries Advisers, requires 15 digital skills, of which 7 are essential digital skills.

**Table 5: Cross referenced occupations related to agri-food sector ISCO group 2132**

ISCO code	Name	Concept description	Preferred skill label
3116	Chemical Engineering Technicians	Application of computers, computer networks and other information technologies and equipment to storing, retrieving, transmitting and manipulating data, in the context of a business or enterprise.	use IT tools
		Select and use ICT systems for a variety of complex tasks in order to meet a variety of needs.	use ICT systems /**
		The branch of chemistry that aims at addressing complex chemical problems through computer simulations.	computational chemistry *
		Translate, by means of computer models and simulations, the specific laboratory formulae and findings into production processes.	translate formulae into processes */**
		Use the chromatography data system software which collects and analyses the chromatography detectors results.	use chromatography software *
6112	Tree and Shrub Crop Growers	Can use Geospatial Technologies which involve GPS (global positioning systems), GIS (geographical information systems), and RS (remote sensing) in the daily work.	handle geospatial technologies */**

		The design and application of innovative ICT solutions in agriculture, horticulture, viticulture, fishery, forestry and livestock management.	e-agriculture *
		The tools involved in geographical mapping and positioning, such as GPS (global positioning systems), GIS (geographical information systems), and RS (remote sensing).	geographic information systems *
		Use relevant information systems and databases to plan, manage and operate agricultural enterprise and production.	use agricultural information systems and databases */**
6114	Mixed Crop Growers	The design and application of innovative ICT solutions in agriculture, horticulture, viticulture, fishery, forestry and livestock management.	e-agriculture *
		Use relevant information systems and databases to plan, manage and operate agricultural enterprise and production.	use agricultural information systems and databases *
7513	Dairy Products Makers	Utilise computers, IT equipment and modern day technology in an efficient way.	have computer literacy
8341	Mobile Farm and Forestry Plant Operators	Select and use ICT systems for a variety of complex tasks in order to meet a variety of needs.	use ICT systems
		Suggest how to solve business issues, using ICT means, so that business processes are improved.	propose ICT solutions to business problems
		Use GPS Systems.	operate GPS systems
		Using modern technologies and equipment with high precision positioning systems, geo-mapping and/or automated steering systems for agricultural activities.	apply precision farming *
9212	Livestock Farm Labourers	The functioning of computer controlled systems that provide animal feeding.	computerised feeding systems */**
9216	Fishery and Aquaculture Labourers	Operate communication devices in order to interact with customers, colleagues, and others.	use communication devices



	Send an alert in case of distress, using any of the various GMDSS radio systems such that the alert has a very high probability of being received by either shore rescue authorities and/or other vessels in the area.	communicate using the global maritime distress and safety system /**
	Utilise water navigation devices, e.g. compass or sextant, or navigational aids such as lighthouses or buoys, radar, satellite, and computer systems, in order to navigate vessels on waterways. Work with recent charts/maps, notices, and publications in order to determine the precise position of a vessel.	use water navigation devices */**

\* Sector-specific skill, otherwise cross-sectoral

\*\* Essential, otherwise optional skill

The result from the table above shows that occupations related to lower skills level, also require less digital skills, i.e. in ESCO database are marked as optional for that specific group.

## 4.2. Mapping of the educational stakeholders - Skills Supply: Training and Education Providers in Agri-Food Sector

### 4.2.1. Macedonian Qualifications Framework

Macedonian Qualifications Framework (MQF) is a mandatory national standard that regulates the acquisition and use of qualifications in the country and a tool for establishing a system of qualifications acquired in the country. MQF has 8 levels and 6 sub levels.

**Table 6: Macedonian Qualification Framework**

NQF levels		Educational qualifications	Vocational qualifications*	EQF
8		Doctorate diploma	NVQ	8
7	A	Second cycle Master of Science diploma (from 60 to 120 ECTS)	NVQ	7
	B	Second cycle diploma for specialist studies (60 ECTS)	NVQ	
6	A	■ First cycle university diploma (240 ECTS) ■ First cycle vocational diploma (240 ECTS)	NVQ	6
	B	■ First cycle university diploma (180 ECTS) ■ First cycle vocational diploma (180 ECTS)	NVQ	
	A	Short cycle higher education (vocational) diploma	NVQ	

5	B	<ul style="list-style-type: none"> <li>■ Post-secondary diploma for specialist education</li> <li>■ Craftsman diploma</li> </ul>	NVQ	5
4		<ul style="list-style-type: none"> <li>■ Upper secondary general education diploma</li> <li>■ Upper secondary technical diploma</li> <li>■ Upper secondary arts diploma</li> </ul>	NVQ	4
3		Vocational diploma (three years)	NVQ	3
2		Vocational certificate (two years)	NVQ	2
1		Certificate of primary education	NVQ	1

\*According to the law on the NQF, vocational/occupational qualifications can be acquired for part of a formal education programme (modules, courses), by completing a special programme in adult education, or through validation of non-formal learning.

Source: Illustration from the [ETF](#), adopted from the MoES

#### 4.2.2. Formal education in the agri-food sector

Education in agriculture in Macedonia is structured through various programs offered by public universities, with dedicated faculties focusing on agricultural sciences. These institutions aim to provide students with comprehensive knowledge and skills pertinent to the agri-food sector. Despite the availability of these programs, there is insufficient number of students entering the field. This shortage poses potential challenges for the future workforce in agriculture, highlighting the need for increased enrolment and interest in agricultural studies to ensure the sector's sustainable development.

#### Higher education in agri-food sector

University education related to Agriculture is held in public institutions and offered through various study programs within 4 public universities. Currently, there are 4 faculties that offer undergraduate programmes for studies in agriculture:

- [Faculty of Agriculture- University Goce Delchev - Shtip;](#)
- [Faculty of Biotechnological Sciences- University St. Kliment Ohridski-Bitola;](#)
- [Faculty of Agricultural Sciences and Food- University Ss Cyril and Methodius-Skopje, and](#)
- [Faculty of Food Technology and Nutrition- State University-Tetovo.](#)

Statistics on graduation from tertiary education by field of study, show that less than 2% of graduates in the country are coming from the educational fields of Agriculture, forestry, fisheries and veterinary studies. Such small number of graduation students raised concerns that the agri-food sector will face serious shortages in skills and qualifications in near future.

In order to overcome deficiencies of digital skills in sector, the Faculty of Agricultural Sciences and Food at the University of Ss. Cyril and Methodius in Skopje has launched a new study

program in Digital Agriculture. This program, developed in collaboration with several other faculties, aims to equip students with expertise in both agricultural sciences and digital technologies. The curriculum includes practical training in partnership with the industry, preparing graduates to modernize the agricultural sector with innovative digital solutions. This initiative aims to create a new generation of highly skilled professionals capable of enhancing the efficiency and competitiveness of agriculture on both national and international levels.

**Table 7: Graduated students by field of study- ISCED 2013, and reporting year**

year	2021	2022	2023
<b>Total</b>	7,753	7,483	7,422
<b>Agriculture, forestry, fisheries and veterinary</b>	145	120	134
<b>Percentage of total</b>	1.9	1.6	1.8

Source: [Makstat](#), author's representation

### Vocational education in agri-food sector

Interest in vocational education in agri-food profiles is decreasing over the years, and students who graduated from educational programmes in agriculture, veterinary medicine, veterinary in school year 2020/2021 was 331, and decreased to 247 students in school year 2022/2023. Compared as share of all graduated in vocational education, educational programmes in agriculture and veterinary branches consist only 4.7% of all graduated.

Currently, in the [register](#) of adopted qualification standards, there are **106 standards**, of which 10 are in the field of Agriculture, fishing and veterinary medicine.

**Table 8: Qualification standards in Agriculture, veterinary medicine**

Sector	Name of qualification	NQF Level
Agriculture, fishing and veterinary medicine	Technician for phytomedicine	4
	Agrotechnician for traditional and organic production	4
	Agrotechnician	4
	Technician in veterinary medicine	4
	Technician in agromanagement	4
	Winegrower	3
	Florist	3
	Herder	3
	Gardener	2

Crop producer	3
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Source: [Register of the qualification standards](#)

In the announcement for enrolment in public schools for the academic year 2024/2025 by the Ministry of Education and Science, vocational education programmes in agriculture and veterinary medicine can be pursued in 10 public high schools. Most of these programs are offered in conjunction with gymnasium and other vocational programmes. The profiles available by school and town are following:

**Table 9: VET schools by town and profile in agriculture**

No.	Name of school	Town	Profiles
1.	SOZU "Kuzman Shapkarev"	Bitola	Agrotechnician, Technician in agromanagement, Technician in phytomedicine, Agrotechnician for traditional and organic production
2.	SOU "Gotce Delchev"	Valandovo	Technician in phytomedicine, Agrotechnician
3.	SOZSU "Gjorche Petrov"	Kavadarci	Technician in phytomedicine, Agrotechnician/ agromanagement, Agrotechnician for traditional and organic production
4.	DSU and Regional Center for vocational education "Kiro Burnaz"	Kumanovo	Technician in phytomedicine, Agrotechnician/ agromanagement, Technician in veterinary medicine
5.	SOU "Orde Chopela"	Prilep	Agrotechnician/ agromanagement, Technician in veterinary medicine, Technician in phytomedicine, Agrotechnician for traditional and organic production
6.	SOU "Tzar Samoil"	Resen	Agrotechnician, Technician in phytomedicine
7.	SOU "Kocho Racin"	Sveti Nikole	Agrotechnician/ agromanagement, Agrotechnician for traditional and organic production
8.	SUGS "Brakja Miladinovci"	Skopje	Technician in veterinary medicine, Agrotechnician, Technician in phytomedicine, Technician in agromanagement, Agrotechnician for traditional and organic production

9.	SOU “Dimitar Vlahov”	Strumica	Agrotechnician, Technician in agromanagement, Technician in phytomedicine, Crop producer, Technician in veterinary medicine
10.	SOSU Regional Center for vocational education “Mosha Pijade”	Tetovo	Technician in veterinary medicine / Technician in phytomedicine, Agrotechnician

Source: Ministry of Education and Science [MoES](#)

The concern over low levels of graduation in VET schools in the agri-food sector is aggravated by the low levels of employment in the sector in North Macedonia. Several reasons contribute to this situation: many see agriculture as side work, i.e. for additional income and do not want to work in the sector that is lagging in salaries, productivity and technological processes. Additionally, many agricultural workers from the rural places see the opportunity to work as agricultural seasonal workers in Western European countries (mostly Italy, Germany and Croatia), and earn more money in up to three months, rather than working around the year in the country. Data from Eurostat show that at the end of 2021, around 33,000 citizens of North Macedonia hold a residence permit for employment reasons, issued by the EU 27 countries and EFTA countries<sup>13</sup>.

Starting from January 2025, dual education is regulated by the Law on Vocational Education and Training<sup>14</sup> and is expected to create stronger partnerships on local level among stakeholders involved (companies, VET schools, municipalities) and adapt the workforce to the qualifications and skills demanded on labour market.

#### **4.2.3. Non-formal education**

Open Civic Universities (OCU), are founded by the Law on Open Civic Universities and lifelong learning (Official gazette [36/2011](#)) and amended in the years 2014, 2015, 2016 and 2018. OCU's are successors of the Workers Universities and can offer formal and non-formal educational programmes.

With the enactment of the Law on OCU, the property of the workers and people's universities which belonged to the state, were transferred to the governance of municipalities., Only few OCU's are currently functioning in the country and offering training programmes. There is no data available on trainings and programmes offered by the OCUs.

To improve the current situation, it is necessary to enhance the capacities of the OCU through better management and increased funding opportunities. Additionally, there should be a focus on increasing and supporting agricultural training programme submissions to AEC and fostering industry collaboration to align training with sector needs.

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<sup>13</sup> Source: [Eurostat](#)

<sup>14</sup> New [Law on VET](#) was introduced in December 2024.

## Adult education

Adult Education Center (AEC) is public institution established in 2008 in accordance with the Law on Adult Education (Official gazette 7/2008). A new adult education law was introduced in January 2025, with new regulations and rulebooks expected to be developed by mid-2025.

AEC currently maintains a register of verified educational programmes that includes a limited number of training programmes in agriculture, indicating that the interest for providing trainings in in this field by training providers is very low. During the desktop research, it were identified various IT course offerings, primarily focused on administration software use and computer literacy.

## Continuous and lifelong learning in agri-food

In accordance with the article 141 of the Law on Higher education (Official gazette 82/2018) amended in 2019, 2021 and 2024, universities can establish Centres for lifelong learning and offer continual professional development and non-formal training courses. However, the system of organising the study programs, curricula development, duration and certification is prescribed within university internal acts.

There are no available structural statistics on such training delivered by the universities by field of study, credits, students (for example published by the State Statistical Office). Exceptions are the regulated professions (such as medicine personnel, pharmacist and similar) whose evidence are held by the respective chambers of profession. Respectively, it is expected that some professions in agri-food sector receive the **status of regulated profession** and continual professional development would be mandatory. Currently, professional development courses and non-formal courses are not mandatory in the professions within the agri-food sector and there is little interest in following the courses in the area.

Another example of nonformal education is the one provided by private companies. To meet needs for skilled workforce, several companies have founded own training centres in confectionary industry<sup>15</sup> and wine market<sup>16</sup>, creating own training centre where specific non-formal short-term courses and modules will be delivered to employees in order to fill the skills gaps.

### 4.2.4. The role of the National Extension Agency in education and training

National extension agency for supporting the agriculture production (NEASAP) is a state agency founded by the Law on founding National agency for supporting the agriculture production in 1998 (Official gazette 3/1998) and amended in 2014, 2018 and 2019. The NEASAP has around 220 employees and offices in 30 towns and dispersed offices in 44 rural places across the country. The mission of the NEASAP is to provide counselling services to the agricultural producers, trainings, transfer of know-how, tutoring, introducing and establishing informative

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<sup>15</sup> One of the biggest agri-food companies in the country in partnership with the European Bank for Reconstruction and Development (EBRD) have formed a training center "Progressive Academy" where new employed can attend courses in operating with confectionary equipment and produce of chocolate products.

<sup>16</sup> Winery Kamnik opened training center for the "Wine advisor" which is certified by the Adult Education Center.

systems in the agriculture, providing mentorship in production and other type of professional and informative support related to agricultural production. NEASAP has around 85 professionals who are providing counselling services related to soiling, fertilisation, applying pesticides and other farming operations to the agricultural producers, upon their request. However, the profile of the professionals and area of specialty in which counselling and training modules are provided to the interested farmers are unknown. Certification and regulation of the profession “counselling and training in agriculture”, was suggested among interviewed stakeholders.

### 4.3. Findings from Focus Groups

As part of the SMARTLABOR project, two focus group discussions were held in July 2024 in Skopje which gathered insights from key stakeholders in the agri-food sector. The first, on July 3, involved 12 participants from academia, education, business, CSOs, and policymakers, focusing on skills gaps and integrating digital skills into agriculture. The second focus group discussion which took place on July 4, included 7 participants from Serbia, North Macedonia and BiH, discussing regional cooperation, digital innovations, and aligning the sector with EU standards. Both sessions highlighted strategies for addressing challenges and promoting sustainable, technology-driven agriculture.

## 5. DIGITALISATION IN AGRICULTURE

Digital skills in agri-food sector refer to the use of technology and digital tools which can improve various aspects of farming in agriculture and food production. These skills can be used to increase efficiency, productivity, and profitability in agriculture, as well as to improve environmental sustainability and food security. Examples of digital skills and competences that were discussed as relevant to agriculture nowadays include:

- **Data analysis and management:** Applying tools like spreadsheets and specialized software (electronic diaries, calendar and similar) to collect, analyse and manage data related to farming operations, such as soil analysis, crop yields, and irrigation schedules.
- **Precision agriculture:** Applying technology like GPS and sensors to gather data on soil conditions, weather patterns, crop growth, and using this data to optimize farming practices, such as applying fertilizers and pesticides more efficiently.
- **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 timely decisions about irrigation, fertilization, 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.
- **Crop monitoring and prediction:** Using data analysis and machine learning techniques to predict crop yields and optimize farming practices based on weather patterns and other factors that can affect the growing processes.

During the focus groups interviews, there was a consensus among interviewees that the digitalisation in the agri-food sector in the country is among the most underdeveloped activities.

## **5.1. Digital skills demand in agri-food sector**

During the interview process, the representatives from several small and medium-sized enterprises (SMEs) were consulted to gain a deeper understanding of the digitalisation processes within the agri-food sector.

Most of the companies which operate in the digitalisation in agriculture rely on workers who possess tertiary education in the fields related to computer science, software development, agriculture and economics. Their teams are composed of small core team with full time employees and often use local external experts, and to less extent, rely on experts from abroad especially to solve a task that needs high level of speciality which is not available in the country. From the perspective of training of the employees, companies use different models. Some of the companies are training their staff in-house, which usually takes 3-6 months, while others rely on online courses and subscriptions offered by vendors, especially the staff working in software engineering and programming.

### **5.1.1. Provision of digital skills in agri-food sector**

The link between companies in the sector and VET schools in agri-food is based on ad-hoc basis, i.e. the company representatives in cooperation with the schools may provide trainings on use of drones, software for high precision aerial 3D maps, robots for applying pesticides and similar modern technological solutions to the high school students, while there are not yet specific curricula that can offer continual and updated usage of such products and services.

To support continuity in the process and introduce new techniques and technologies, two enabling factors were mentioned: the need to train and educate the VET professors with the subjects related to use of digital technologies; and equip laboratories and workshops where novelty technologies might be taught.

Cooperation with the scientific and research centres is occasional and project based, where most of the funds are coming from donor funds, such as Horizon 2020, Erasmus+ and similar programmes.

Business accelerators rarely have trainings and systemic support for digitalization in agri-food sector. Some of the companies in the sector have benefited financial support from the accelerators in form of training and counselling, however these are limited cases and small funds are usually spent on purchase of equipment and staff salaries.

Faculties of electronics, software engineering and informatics, in the country have more advanced trainings in terms of digital training curricula, such as Artificial Intelligence, Machine Learning, IoT, programming/coding and design of digital tools, however, there is little evidence that professionals with this type of educational background are engaged in the agri-food sector.



### 5.1.2. Matching the demand and supply for digital skills in agri-food

Matching the demand and supply of skills is challenging in the sector. Skills needs demanded by employers change rapidly, and the available workforce skills are mainly not ready to meet the demand. Hence, skills shortages in the sector create risks and obstacles for development of the sector.

During the discussions with the focus groups representatives held in July 2024, several suggestions were underlined.

**Skills mismatch:** There is a significant gap between the digital skills required by employers in the agri-food sector and the skills possessed by the current workforce. This mismatch is exacerbated by the rapid advancement of technology and the slow adaptation of educational curricula.

**Low attraction:** The agri-food sector struggles to attract workers with ICT educational backgrounds due to lower salaries compared to other sectors like IT and financial sectors. This makes it challenging to integrate highly skilled workforce into the sector.

**Resistance to change:** There is often resistance to change within the workforce in agri-food sector, with many workers and businesses preferring to stick to traditional methods. This can make it difficult to implement new digital technologies and practices.

## 6. CONCLUSIONS

1. Lack of training and education on digital skills in the VET schools along with the rapid advancement in technology has rendered certain profiles obsolete. Current curricula in agricultural VET schools offer programmes with the necessary skills, but they are not up to date with the latest technologies and best practices in the field.

2. It is imperative to strengthen the links between employers and training providers, including civic universities and non-formal training centres. The involvement of relevant institutions will play a crucial role in ensuring the sustainability of educational and training processes. Additionally, leveraging opportunities provided by EU accession funds will further contribute to the enhancement and continuity of these efforts. Establishing partnerships and fostering collaboration among all stakeholders will not only secure the longevity of educational programs but also ensure their alignment with the evolving needs of the labour market.

3. The agri-food sector in the country currently faces limited adoption of digital tools and practices due to small farm sizes, lack of financial capacities and insufficient knowledge transfer. To address this, it is essential to provide tools and training to improve digital literacy across the agri-food chain, enabling better farm management, communication, and e-commerce. Implementing programs to co-finance digital solutions for automation and modernization of processing facilities, and encouraging the use of drones, IoT devices, and ERP systems, will further enhance digital adoption. Additionally, creating digital public e-services platforms for all

stages and actors in the agri-food chain will simplify procedures and improve access to information, while promoting precision agriculture programs, including the use of satellites and drones, will optimize crop growth and health.

4. Macedonian agri-food sector holds significant potential for driving rural development and aligning with European sustainability standards. However, realizing this potential requires a coordinated approach to skills development, involving all stakeholders. By addressing existing gaps and fostering collaboration, the country can establish an adaptive and resilient workforce prepared to meet the demands of a modernized agri-food sector.

5. Continuous monitoring of labour market trends, coupled with responsive education and training systems, will ensure long-term competitiveness and sustainable growth in the sector. With the right policies, partnerships, and investments, Macedonian agri-food workforce can become a strong point for national development.

6. Smart Specialization Strategy (S3) is a result of multiannual research and consultations with national stakeholders, supported by experts from the EU. One of the four priority domains identified is Smart Agriculture and Food with Higher Added Value. To successfully implement the S3 strategy, it is essential to foster strong collaboration between government, industry, and educational institutions. This also means that the action plans need to be implemented satisfactorily, and its implementation monitored and evaluated.

## 7. RECOMMENDATIONS

**Develop and integrate digital skills in education:** Incorporate digital tools and technologies into VET schools and higher education curricula, covering areas such as precision agriculture, data management, drone technologies, and online marketing. This is important to equip students with the knowledge and skills required for modern agricultural practices, increasing their employability and ensuring they can contribute effectively to the sector.

**Foster partnerships between educational institutions and industry:** The establishment of Regional Vocational Education and Training (VET) centres in secondary education is planned to include eight centres across all planning regions. By the end of 2024, three regional VET centres were operational in Ohrid, Tetovo, and Kumanovo, with two additional centres under development and three municipal VET schools expected to transform into Regional VET centres. These centres aim to create regional hubs for knowledge exchange where schools, non-formal education centres, and agri-food companies collaborate on curriculum development and skills assessment to align training programs with industry needs. Strengthened collaboration would ensure a direct link between education and practical application, enabling students to receive training that is relevant and valuable to the current job market.

**Increase funding for vocational training centres in rural areas:** Expand non-formal education and vocational training programs, especially in rural areas and individual farmers, with tailored short courses addressing agribusiness management, sustainable production techniques, and advanced farming methodologies. By increasing access to education and

training, particularly in underserved rural areas, the sector can build a more skilled and adaptable workforce that meets regional needs.

**Establish a skills observatory:** Implement a robust system using employer surveys, tracer studies, and scenario analyses to identify future skills needs and ensure that education and training programs remain relevant and responsive to labour market demands. This system is common among EU countries and essential for proactively addressing skills gaps.

## REFERENCES

1. Employment Service Agency. (2024). *Skills needs analysis for 2024*. <http://makstat.stat.gov.mk>
2. European Commission. (2024). *North Macedonia: Agriculture and rural development*. [https://agriculture.ec.europa.eu/media/news/european-commission-will-support-agriculture-and-rural-development-pre-accession-countries-over-2022-03-23\\_en](https://agriculture.ec.europa.eu/media/news/european-commission-will-support-agriculture-and-rural-development-pre-accession-countries-over-2022-03-23_en)
3. Eurostat. (2021). *Residence permits for employment reasons*. <http://epp.eurostat.ec.europa.eu>
4. Food and Agriculture Organization of the United Nations. (2023). *Opportunities and challenges*. <https://www.fao.org/agroinformatics/en>
5. IMPETUS. (2025). *Online presentation of the national report: Mapping and analysis of education and training capacities in North Macedonia's agri-food sector*. <https://impetus.mk/online-presentation-of-the-national-report-mapping-and-analysis-of-education-and-training-capacities-in-north-macedonias-agri-food-sector/>
6. Ministry of Agriculture, Forestry, and Water Economy. (2021). *Strategy for agricultural and rural development 2021–2027*. <http://agriculture.gov.mk>
7. Ministry of Education and Science. (2024). *Announcement for enrolment in public schools for the academic year 2024/2025*. <http://mon.gov.mk>
8. Ministry of Education and Science. (2024). *Law on higher education*. <http://mon.gov.mk>
9. Ministry of Education and Science. (2024). *Law on open civic universities and lifelong learning*. <http://mon.gov.mk>
10. Ministry of Education and Science. (2024). *New law on vocational education and training*. <http://mon.gov.mk>
11. Ministry of Education and Science. (2024). *Register of the qualification standards*. <http://mon.gov.mk>
12. Ministry of Education and Science. (2025). *New adult education law*. <http://mon.gov.mk>
13. Ministry of Finance of the Republic of North Macedonia. (2024). *Preliminary data for 2024*. <http://finance.gov.mk>
14. National Extension Agency. (2019). *Law on founding National Agency for supporting the agriculture production*. <http://nea.gov.mk>
15. Ryan, M. (2023). Labour and skills shortages in the agro-food sector. *OECD Food, Agriculture and Fisheries Papers*, (189). OECD Publishing. <https://doi.org/10.1787/ed758aab-en>
16. State Statistical Office. (2023). *Labour force survey*. <http://makstat.stat.gov.mk>

- 17.State Statistical Office. (2023). *Statistical yearbook*. <http://makstat.stat.gov.mk>
- 18.State Statistical Office. (2024). *Trade statistics for 2023*. <http://makstat.stat.gov.mk>
- 19.State Statistical Office. (2024). *Wages in agriculture sector*. <http://makstat.stat.gov.mk>
- 20.United Nations Development Programme. (2024). *Bridging the skills gap to create new and better jobs*. <https://www.undp.org/north-macedonia/projects/bridging-skills-gap-create-new-and-better-jobs>
- 21.World Bank. (2024). *North Macedonia: Agricultural sector review*. <https://documents1.worldbank.org/curated/en/540801560754049765/pdf/North-Macedonia-Special-Focus-Note-Agriculture.pdf>
- 22.World Economic Forum. (2024). *Future of jobs report 2025*. <https://www.weforum.org/publications/the-future-of-jobs-report-2025/digest/>
- 23.World Food Programme. (2023). *Enhancing food security through education in North Macedonia*. Retrieved from [WFP](#) .

