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# BRIDGING THE GAP BETWEEN AGRICULTURAL EDUCATION AND LABOR MARKET NEEDS: EMPLOYABILITY AND PERCEPTIONS OF AGRICULTURAL ENGINEERING GRADUATES IN NORTH MACEDONIA

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## ABSTRACT

Over the past decade, there has been a significant decline in interest in studying agricultural sciences in North Macedonia. This decrease is primarily attributed to labor market fluctuations in the agricultural sector, which differ substantially from other sectors in terms of dynamics and challenges. To address this issue, a comprehensive study was conducted at the Faculty of Agricultural Sciences and Food - Skopje (FASF), Ss. Cyril and Methodius University in Skopje (UKIM). The study focused on the employability, income levels, and perceptions of graduates in agricultural engineering, but also the perceptions of the employers on the profile of an agricultural engineer envisioned by the different profiles of employers in the sector. The findings highlight the need for targeted educational actions and employment policies to address the identified challenges and opportunities, particularly for highly qualified personnel in the sector.

**Key words**: Agricultural engineers, employability; labour market, graduate perceptions, North Macedonia.

## INTRODUCTION

The agricultural labor market in North Macedonia faces significant challenges, underscored by a steep decline in student interest in agricultural studies. Since 2000, enrolment at the Faculty of Agricultural Sciences and Food – Skopje (FASF), the leading institution for agricultural education in the country, has plummeted nearly tenfold. Contributing factors include rural-urban income disparities, low agricultural wages, and limited career prospects for highly educated professionals. These challenges align with broader trends observed across the Balkans and globally, where agricultural education struggles to attract students amid shifting economic and social dynamics.

This paper offers a detailed analysis of the agricultural labor market in North Macedonia, focusing on the perspectives of agricultural engineering graduates from FASF. By examining employability rates, income levels, and graduates' satisfaction, it identifies critical challenges and opportunities for improving educational and employment strategies in agriculture. The research adopts a mixed-methods approach, combining quantitative data analysis with qualitative surveys. A sample of agricultural engineering graduates from FASF

was analyzed to assess their employment status, job alignment with qualifications, and salary levels. Furthermore, surveys captured graduates' perceptions of their education and its relevance to their professional roles.

The agricultural labor market is distinct from other sectors, necessitating targeted approaches for effective analysis and intervention. Predictive studies by the European Commission suggest that technological advancements will increase labor costs and demand for highly skilled workers in agriculture. However, agricultural employment remains predominantly associated with lower educational attainment, with higher education often inversely correlated with sector employment.

This study focuses on four key objectives:

1. Assessing employability: Understanding how well agricultural engineering graduates' qualifications align with their employment.
2. Analyzing wage structures: Evaluating income levels as a significant factor influencing job retention and satisfaction.
3. Exploring graduate perceptions: Investigating how graduates view their competencies, professions, and current roles.
4. Mapping employment opportunities: Identifying key employers and opportunities for highly qualified individuals in the agricultural sector.

The analysis is based on data from FASF graduates, providing a comprehensive overview of their labor market conditions and offering insights to inform policies aimed at enhancing their employability. The decline in interest in agricultural studies in North Macedonia highlights broader systemic issues in the agricultural labor market. To reverse this trend, it is essential to: enhance agricultural education: Update curricula and integrate practical training to improve relevance, promote career opportunities: Implement financial incentives and awareness campaigns to attract talents, strengthen collaboration: Foster partnerships between universities, government, and industry to create a supportive ecosystem for agricultural innovation and employment. Addressing these challenges will better position North Macedonia's agricultural sector to attract and retain highly skilled professionals, driving sustainable growth and development.

## MATERIALS AND METHODS

This study adopts a mixed-methods approach, integrating both quantitative primary data and secondary data sources to analyze labor market dynamics in the agricultural sector. Secondary data were obtained from the State Statistical Office of the Republic of North Macedonia and the Faculty of Agricultural Sciences and Food – Skopje. These were complemented by a review of relevant academic literature, policy reports, and sectoral analyses to contextualize the empirical findings. Primary data collection was conducted through structured survey instruments, enabling systematic measurement of graduate employability, job characteristics, and employer requirements.

A structured questionnaire was developed, consisting predominantly of closed-ended questions to ensure consistency, reliability, and suitability for statistical analysis. The questionnaire was organized into four thematic sections:

1. Socio-demographic characteristics (gender, age, region of origin, residence, education);
2. Employability indicators (employment status, time to first employment, job mobility);
3. Job quality and remuneration (salary levels, contract type, job–qualification match);
4. Perception variables (attitudes toward the agricultural sector, education relevance, and career expectations).

Key variables were operationalized as categorical and ordinal measures, allowing for descriptive and comparative statistical analysis.

**Graduate survey and sampling strategy -** The graduate survey was conducted in **2022** and targeted individuals who graduated between the academic years **2016/2017 and 2020/2021** from the Faculty of Agricultural Sciences and Food – Skopje. A total of **85 respondents** participated in the survey. The sampling frame was defined based on the population of graduates within the specified period, ensuring adequate coverage across study programs. While the sampling approach can be characterized as **representative within the institutional context**, it remains subject to typical survey limitations such as voluntary response bias. The sample exhibits a **balanced gender structure** (55% female, 45% male) and is predominantly composed of respondents from **urban areas**, reflecting disparities in access to higher education and employment opportunities.

Regionally, there is a marked concentration of respondents from the **Skopje region (n = 42)**, with limited representation from other regions, particularly **Polog (n = 1)** and **Southeast (n = 2)**. This distribution suggests spatial concentration of human capital and potential internal migration patterns. Additionally, comparison between place of birth and current residence was used as a proxy indicator for **geographical mobility**.

**Employer survey -** To incorporate the **demand-side perspective**, a complementary survey targeting employers in the agricultural sector was conducted. The employer sample included **four purposively selected organizations** representing key subsectors: public administration, agribusiness, mixed agricultural production, agricultural advisory and technology services. The selection aimed to capture diverse employer perspectives regarding required competencies, qualifications, and skill gaps among agricultural engineering graduates. In parallel, a **mapping exercise of employers** across subsectors was performed to identify major employment opportunities and assess alignment between educational outcomes and labor market needs.

**Follow-up survey -** A follow-up survey was conducted in **2024** to assess changes in perceptions over time and to evaluate the reception of the newly introduced study-program in **Digital Agriculture**. The follow-up included **41 respondents**, approximately 50% of the original sample, allowing for a **partial longitudinal comparison**. This component provides insights into evolving attitudes toward employability, sector attractiveness, and the relevance of educational reforms.

The data analysis was performed using **descriptive statistical techniques**, including frequency distributions, percentages, and cross-tabulations. In addition, **comparative analysis** was applied to examine relationships between key variables, such as: socio-demographic characteristics and employment outcomes, education and job–skill alignment, perceptions and career trajectories. Although the study primarily relies on descriptive statistics, the analytical approach allows for the identification of **patterns, structural constraints, and emerging trends** in the agricultural labor market.

**Methodological limitations -** Several limitations should be acknowledged. First, the study is based on a **single-institution sample**, which may limit the generalizability of findings at the national level. Second, the reliance on **self-reported data** introduces the possibility of response bias. Third, the sample size, particularly in the employer survey, remains limited.

Despite these constraints, the study provides **robust indicative insights** into the employability of agricultural graduates and the alignment between higher education and labor market demands in North Macedonia.

## Literature Review

Interest in studying agricultural sciences across the European Union and globally varies depending on the country, regional needs, and emerging trends in agriculture, technology, and sustainable development. On average, only 8.5% of European farmers have received formal agricultural training, while 70% rely solely on practical experience (2017). Initial training is the responsibility of national governments, with agricultural education systems differing significantly among EU member states. These systems offer diverse career pathways in agriculture and forestry, ranging from vocational courses to degrees, master's programs, and doctorates in applied sciences.

The EU's Common Agricultural Policy (CAP) emphasizes knowledge sharing and innovation, providing specific measures to support farmers with advisory services and training throughout their careers. Furthermore, the European Innovation Partnership for Agricultural Productivity and Sustainability (EIP-Agri) support innovation in the sector. Recent resolutions by the European Parliament underline the importance of education and training as key tools for enhancing farmers' ability to adapt to an ever-changing agricultural landscape.

In North Macedonia, 13 secondary schools provide education in agri-food sciences, while 13 faculties and six institutes across five universities offer higher education in the field. These institutions are often competitive, offering similar curricula. However, the number of students in the country has declined by 7,043 in the past decade, representing a 12% decrease, as reported by the Center for Civil Communications (CCC) at the start of the 2024/2025 academic year. This decline is largely attributed to migration trends that affect overall enrolment in all universities in North Macedonia. According to CCC research (2024), the number of students enrolled in the Faculty of Agricultural Sciences and Food at Ss. Cyril and Methodius University (FASF/UKIM) has dropped by nearly 60% over the past 10 years.

The declining interest among young people in pursuing agricultural education poses a serious threat to future food security and social stability. Ageing populations in rural areas and a global trend of fewer young individuals choosing agricultural careers underscore the need to understand the perspectives of young individuals on agriculture. Analysing the factors that shape perceptions and reduce the appeal of agricultural careers is crucial for fostering engagement in the sector.

The labor market for graduates in agricultural sciences faces numerous challenges and changes driven by technological innovations and the evolving agricultural sector. Agriculture is undergoing a significant transformation, fuelled by technological advancements, market shifts, and increased sustainability demands, which require a diverse skill set. Job advertisements increasingly emphasise digital literacy, data analysis, communication skills, environmental awareness, critical thinking, and self-management. Farmers prioritize resource management

and problem-solving, while students value sales, decision-making, and collaboration. Leadership, creativity, and adaptability are vital for navigating the complexities of modern agricultural practices.

Nevertheless, there is a notable gap in the development of skills such as negotiation, innovation, and teaching abilities, which are likely to become crucial for the sector's future. Farmers and students alike are recognising the need for specialized skills in sustainability, smart technologies, and natural resource management. The labor market demands graduates with strong technical expertise and soft skills, such as leadership and communication.

To enhance employability, stronger collaboration between universities and the industry is essential. Introducing internship programs and supporting young entrepreneurs could significantly increase interest in agricultural careers. Sustainability and digitalization will continue to shape labor market needs, underscoring the importance of interdisciplinary skills. Joint activities, such as panel discussions, networking events, and collaborative initiatives, are crucial for elevating the profile of agricultural graduates.

A notable example is Purdue University's Institute for Digital and Advanced Agricultural Systems (IDAAS), which unites academic and industry leaders to address agricultural challenges through data-driven technologies. Such efforts foster innovation, connect diverse expertise, and equip graduates with advanced skills for the future of agriculture. The institute also develops new courses in digital agriculture, covering programming, sensors, and data management to prepare students for the workforce's evolving demands.

## RESULTS AND DISCUSSION

### Education, skills development, and perceived study quality

The findings indicate that the educational trajectories of agricultural engineering graduates are characterized by limited continuation into higher levels of formal education. A substantial majority of respondents (91%) did not pursue postgraduate studies, with only a small number enrolled in master's (n = 6) and doctoral programs (n = 1). Despite this, nearly all respondents reported participation in additional training activities between 2019 and 2021, suggesting a strong reliance on non-formal education and an awareness of the importance of lifelong learning.

On average, students completed their studies in 5.6 years, although durations varied significantly, pointing to differences in study progression and potential structural inefficiencies. In terms of perceived relevance, 62% of respondents considered their studies adequate for employment, while a significant 38% expressed dissatisfaction, indicating a mismatch between acquired competencies and labor market requirements.

Qualitative insights reinforce this perception. The most frequently cited concern is the lack of practical training, including insufficient fieldwork, laboratory exercises, and applied learning opportunities. Respondents also highlighted outdated curricula and limited specialization aligned with evolving labor market needs. Additional concerns include weak career guidance services and insufficient institutional support for job placement, which may hinder the transition from education to employment.

Experiences with academic staff were mixed, ranging from positive evaluations of engagement to criticism of limited involvement. Structural constraints—such as inadequate infrastructure and administrative inefficiencies—were also noted. Furthermore, limited collaboration with industry stakeholders and international institutions, particularly within the European context, emerged as a key weakness. Nevertheless, some respondents expressed overall satisfaction, indicating that the system retains certain strengths despite these shortcomings.

**Employment outcomes and labor market integration**

Employment outcomes appear relatively favorable, with over 73% of respondents currently employed. The transition from education to employment is generally efficient, as most graduates secured their first job within one year of graduation. On average, respondents reported holding 2.4 jobs and accumulating 4.2 years of work experience, suggesting early-career mobility.

Most respondents are engaged in relatively stable employment, with 39 holding permanent contracts. However, a notable proportion are employed under less secure arrangements, including service contracts (n = 13) and temporary positions (n = 5), while a small number are self-employed (n = 3).

Although 53% of respondents are employed within the agricultural sector, a significant share has transitioned to other sectors, indicating partial outflow of human capital. Perceptions of sectoral opportunities are divided: 52% view them positively, while 48% perceive them as limited, reflecting uncertainty regarding the sector's capacity to absorb skilled graduates.

**Employers, sectoral distribution, and job search behavior**

Employment is dominated by the private sector, with graduates distributed across primary agricultural production (22%), processing (24%), and trade and related services (27%), including consulting, logistics, and IT. Public sector employment also remains relevant, particularly in institutions such as the Ministry of Agriculture, Forestry and Water Economy, the Agency for Financial Support in Agriculture and Rural Development, and the State Statistical Office.

Despite the prevalence of private sector employment, respondents expressed a preference for public sector jobs, likely due to perceived job security. Job search behavior relies on both formal and informal channels. Most respondents use job advertisements (n = 42), followed by personal networks (n = 20). In contrast, institutional support from faculties is minimal, with only two respondents identifying it as helpful. This highlights weak university–labor market linkages.

**Income and job satisfaction**

Income levels among respondents are relatively modest. The largest group (n = 43) earns between 20,000 and 30,000 Macedonian denars (MKD – 1 MKD is equal to 0.016 EUR), below the national agricultural average (34,400 MKD in 2021). An additional 15 respondents earn less than 20,000 MKD, while only 8 report earnings above 50,000 MKD. These income patterns are reflected in job satisfaction, with 71% expressing dissatisfaction with their salary. This suggests a clear gap between expectations and actual labor market outcomes, reinforcing concerns about the sector's attractiveness.

### Future perspectives and migration intentions

The results reveal considerable uncertainty regarding long-term career prospects in agriculture. A majority of respondents (69%) do not see their future in the sector, indicating low attractiveness and structural constraints.

Migration intentions are also significant: while 62% plan to remain in the country, 38% are considering emigration. Notably, 64% believe they could find employment abroad in their field, reflecting strong perceived opportunities in international labor markets and reinforcing both push and pull migration factors.

### Follow-up survey and evolving perceptions

The 2024 follow-up survey confirms the persistence of key challenges. Respondents continue to report negative perceptions of employment opportunities in agriculture, with average scores below the midpoint. Skepticism regarding employability remains evident.

However, there are emerging positive developments. Respondents reported improved perceptions of educational modernization, particularly with newly introduced programs. The "Digital Agriculture" program stands out, with 44% indicating they would choose it if given another opportunity. This suggests that innovation and curriculum modernization can enhance the attractiveness of agricultural education.

### Employer perspectives on skills and employability

Employers consider a university degree a sufficient baseline qualification but emphasize practical experience as critical. Key technical skills include crop production, plant protection, irrigation, and competencies related to digital agriculture and modern production systems.

Soft skills are equally important, particularly communication, problem-solving, data analysis, teamwork, and adaptability. Leadership and time management are valued but ranked lower.

Salary differences between sectors are also evident, with higher earnings typically found in the private sector, potentially influencing career decisions despite preferences for public sector stability.

## CONCLUSIONS

This study provides a comprehensive assessment of the relationship between higher education and labor market outcomes for agricultural engineering graduates in North Macedonia, revealing a set of interrelated structural challenges alongside emerging opportunities for reform. The findings highlight a systemic gap between higher education outcomes and labor market requirements, particularly in relation to practical competencies. Although graduates demonstrate relatively strong labor market integration—evidenced by high employment rates and a relatively short transition period from education to employment—the quality and sustainability of employment remain key concerns. A considerable proportion of graduates are employed outside the agricultural sector, while those within it often face low wages, job insecurity, and limited career advancement opportunities. These factors contribute to high levels of dissatisfaction and reduce the attractiveness of agriculture as a long-term career path. A central issue identified is the misalignment between educational provision and labor market needs. While many respondents perceive their education as broadly adequate,

significant gaps persist in practical training, applied learning, and curriculum relevance. The limited progression to postgraduate education, combined with widespread reliance on non-formal training, indicates that graduates seek alternative pathways to acquire relevant skills. This underscores the need for more practice-oriented and interdisciplinary approaches to agricultural education. Modern agriculture increasingly requires competencies in digitalization, sustainability, and resource management, which remain insufficiently integrated into traditional curricula. The study also reveals weak institutional linkages between higher education and the labor market. Limited career guidance, insufficient job placement support, and inadequate collaboration with industry stakeholders hinder the transition from education to employment and reduce the efficiency of human capital utilization. At the same time, employment patterns reflect a structural trade-off: while the private sector offers relatively higher earnings, graduates continue to prefer public sector employment due to greater perceived stability. Economic factors play a decisive role in shaping career choices. Relatively low-income levels and widespread dissatisfaction with salaries significantly undermine the attractiveness of agricultural professions. This is further reflected in the finding that a majority of graduates do not envision their future within the sector. Migration intentions reinforce these challenges, with a substantial share of respondents considering emigration due to limited domestic opportunities and more favourable prospects abroad—an issue particularly relevant in the Western Balkans context. Despite these constraints, the findings also point to important opportunities for transformation. The strong engagement in lifelong learning, increasing recognition of the importance of digital and modern agricultural skills, and the positive perception of innovative programs such as "Digital Agriculture" suggest that curriculum modernization and technological advancement can enhance both the relevance and attractiveness of agricultural education. Employer perspectives further emphasize the need for a balanced skill set that combines technical expertise with practical experience and transversal competencies, including communication, problem-solving, and adaptability. This highlights the importance of adopting a holistic approach to skills development and aligning educational programs more closely with evolving sectoral demands. Overall, improving graduate employability and strengthening the agricultural sector requires a coordinated and systemic response, including:

- stronger alignment between education and labor market needs,
- increased emphasis on practical training and experiential learning,
- enhanced university–industry collaboration, and
- greater investment in digitalization, innovation, and sustainability.

Addressing these challenges is essential not only for improving individual career outcomes but also for ensuring the long-term sustainability, competitiveness, and resilience of the agricultural sector in North Macedonia.

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