Экономика

Development of cooperation and coordination between universities and small and medium-sized businesses in the agro-industrial complex of Russia, Belarus and Nigeria

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Abstract. **The purpose** is to assess university-SME collaboration in the agro-industrial complex of Russia, Belarus, and Nigeria, with specific focus on identifying key graduate competencies valued by employers and measuring employer satisfaction with those competencies. **Methods.** Mixed-methods approach using expert surveys from employers (66 in Russia, 40 in Belarus, 44 in Nigeria) and students, analyzed through Structural Equation Modeling (SEM) and Principal Component Analysis (PCA). **Results.** University-SME collaboration significantly influences graduate competencies ($\beta = 0.62$ for Russia, $\beta = 0.54$ for Nigeria, $\beta = 0.58$ for Belarus) and employer satisfaction. By means of PCA identified four principal components of graduates' valuable competencies for the employer: 1) technical and analytical skills, 2) interpersonal skills, 3) innovation and global mindset, 4) ethical and social awareness, explaining over 75 % of the variance across all three countries. **Scientific novelty.** The comparative analysis of three different economies allows understanding of how cultural and economic factors influence university-SME collaboration dynamics in the agro-industrial complex. The study provides comprehensive insights into aligning higher education outcomes with labor market needs in the agricultural sectors of Russia, Belarus, and Nigeria through employer perspectives.

Keywords: agro-industrial complex, development of cooperation, coordination of actions, universities, agrarian universities, small and medium-sized businesses (SMEs), employers, employer satisfaction, Triple Helix Model, Human Capital Theory, Social Capital Theory, competencies of university graduates, digital competencies, digitalization of the agro-industrial complex

496

Economy

Развитие сотрудничества и координации действий между университетами и предприятиями малого и среднего бизнеса в АПК России, Беларуси и Нигерии

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Аннотация. **Цель** – оценить сотрудничество университетов и малого и среднего бизнеса в АПК России, Беларуси и Нигерии, уделив особое внимание выявлению ключевых компетенций выпускников, которые ценятся работодателями, и измерению удовлетворенности работодателей этими компетенциями. **Методы.** Подход основан на смешанных методах с использованием экспертных опросов работодателей (66 в России, 40 в Беларуси, 44 в Нигерии) и студентов. Опросы проанализированы с помощью моделирования структурными уравнениями (SEM) и анализа главных компонент (PCA). **Результаты.** Сотрудничество университетов и малого и среднего бизнеса существенно влияет на компетенции выпускников ($\beta = 0,62$ для России, $\beta = 0,54$ для Нигерии, $\beta = 0,58$ для Беларуси) и удовлетворенность работодателя. Посредством метода PCA выделено четыре основных компонента ценных для работодателя компетенций выпускников: 1) технические и аналитические навыки, 2) навыки межличностного общения, 3) инновационный и глобальный подход, 4) этическая и социальная осведомленность, что объясняет более 75 % различий во всех трех странах. **Научная новизна.** Сравнительный анализ трех различных экономик позволяет понять, как культурные и экономические факторы влияют на динамику сотрудничества университетов и малого и среднего бизнеса в АПК. Исследование дает всестороннюю информацию о приведении результатов высшего образования в соответствие с потребностями рынка труда в сельскохозяйственных секторах России, Беларуси и Нигерии с точки зрения работодателей.

Ключевые слова: АПК, развитие сотрудничества, координация действий, университеты, аграрные университеты, вузы, малый и средний бизнес (МСБ), работодатели, удовлетворенность работодателей, модель тройной спирали (Triple Helix Model), теория человеческого капитала, теория социального капитала, компетенции выпускников вузов, цифровые компетенции, цифровизация АПК

Introduction

The dynamic landscape of higher education and evolving job market demands necessitate a closer examination of university-SME collaboration. This is especially important for the agricultural sector, since the agro-industrial complex (here and further – AIC) is responsible for food security, and small and medium-sized businesses play a key role in achieving saturation of the food market with basic foodstuffs. Moreover, it is agricultural universities that form educational programs for future employees of these enterprises to study. Therefore, it is important to understand the nature of cooperation between universities and SMEs. That is why this research focuses on enhancing this

ЭКОНОМИКА

collaboration through employer satisfaction studies of graduate competencies in Russia, Nigeria, and Belarus, three diverse economies with unique challenges in their higher education, AIC and business sectors.

Recent years have seen growing recognition of the need to align higher education outcomes with labor market needs, particularly in emerging economies. As Nieves Arranz et al. note, "... *creating an active collaboration between the university and the company both in-depth and in breadth is a facilitator of the employment of HEIs graduates*" [1].

In Russia, initiatives like Project 5-100 aim to improve university competitiveness globally [2; 3]. Belarus is transitioning from a centrally planned to a market economy, necessitating higher education reforms [4–6]. Nigeria grapples with graduate employability issues, as C. A. Nwajiuba et al. highlight that cooperation between universities and business is at a low level and "*... many HEIs in Nigeria lack the necessary pedagogy, funding and infrastructure to carry out the teaching of employability skills*" [7].

Employer satisfaction studies can provide insights into skills valued by SMEs. Jesús García-Álvarez et al. [8] found that employers prioritize job-related basic skills, socio-relational skills, and self-management skills. In Russia, V. G. Lizunkov et al. [9] noted that employers highly valued team competence, but graduates often lacked this skill. Belarus studies show a disconnection between higher education and societal needs [10]. For Nigeria, I. Otache [11] emphasizes involving business experts in curriculum development.

Enhanced university-SME collaboration offers significant benefits. D. Borah et al. [12] found that graduates from institutions with teaching-focused university-industry collaborations acquire better employability competencies. In Russia, N. Matveeva and A. Ferligoj [3] observed increased cooperation between universities and research institutions after joining Project 5-100.

Belarus is improving higher education quality through international cooperation. For African countries, U. A. Osakede [13] notes: "Entrepreneurship has been identified as the best solution to unemployment, underemployment and poverty among the youths, especially in instances where educated individuals cannot find jobs".

Enhancing university-SME collaboration through employer satisfaction studies of graduate competencies presents a promising avenue for improving higher education quality and graduate employability in Russia, Belarus, and Nigeria. By understanding SME-valued competencies and tailoring educational programs accordingly, universities can better prepare graduates for the job market, addressing critical needs in these countries and contributing to the global discussion on aligning higher education with labor market demands.

It should be noted that the issues we are addressing practically do not concern the field of agriculture. Moreover, we have not found in the literature available to us data on agricultural universities studying cooperation between universities and SMEs in the context of satisfaction with employers' satisfaction with the competencies of university graduates in Russia, Belarus and Nigeria. That is why the specific objectives of our research are to:

1. Assess the current state of university-SME collaboration in Russia, Belarus and Nigeria, with a focus on employer satisfaction regarding graduate competencies of agrarian universities.

2. Identify key graduate competencies valued by SMEs in AIC in Russia, Belarus and Nigeria, comparing and contrasting employer expectations in these three countries.

Methods
The theoretical framework of the study

The interaction between universities and enterprises, particularly small and medium-sized enterprises, is a critical driver of economic development in today's rapidly evolving global landscape. This relationship is especially important in emerging economies like Russia, Belarus and Nigeria, where the need for skilled graduates and innovation is paramount for economic growth. This literature review examines the current state of university-SME collaboration in Russia and Nigeria, focusing on employer satisfaction with graduate competencies and the theoretical frameworks that underpin these relationships and the relationship is presented in Figure 1.

Triple Helix Model

The Triple Helix Model, proposed by Etzkowitz and Leydesdorff, emphasizes university-business-government interaction as a driver of innovation and economic development [14]. In this model it "... considers the interconnected, interdependent and spiraling interaction between innovative agents of government, universities and enterprises in order to produce, transform and transfer knowledge" [4].

In Russia, Project 5-100 exemplify this model, increasing research productivity and expanding cooperation. In addition, the creation of innovation clusters and technology parks also illustrate the interaction between universities and business [15; 19]. Belarus shows progress through innovative industrial clusters [16–18], and including in the field of agriculture [4], and international projects like ERASMUS+ [17; 51]. However, D. Bylaite-Salavejiene and A. García-Aracil [18] suggest stronger institutional reforms are needed to support graduate competencies development.

In Nigeria, C. A. Nwajiuba et al. [7] emphasize the need for the formation of such a culture and environment that would promote cooperation between universities, industry (including agricultural production) and public administration.
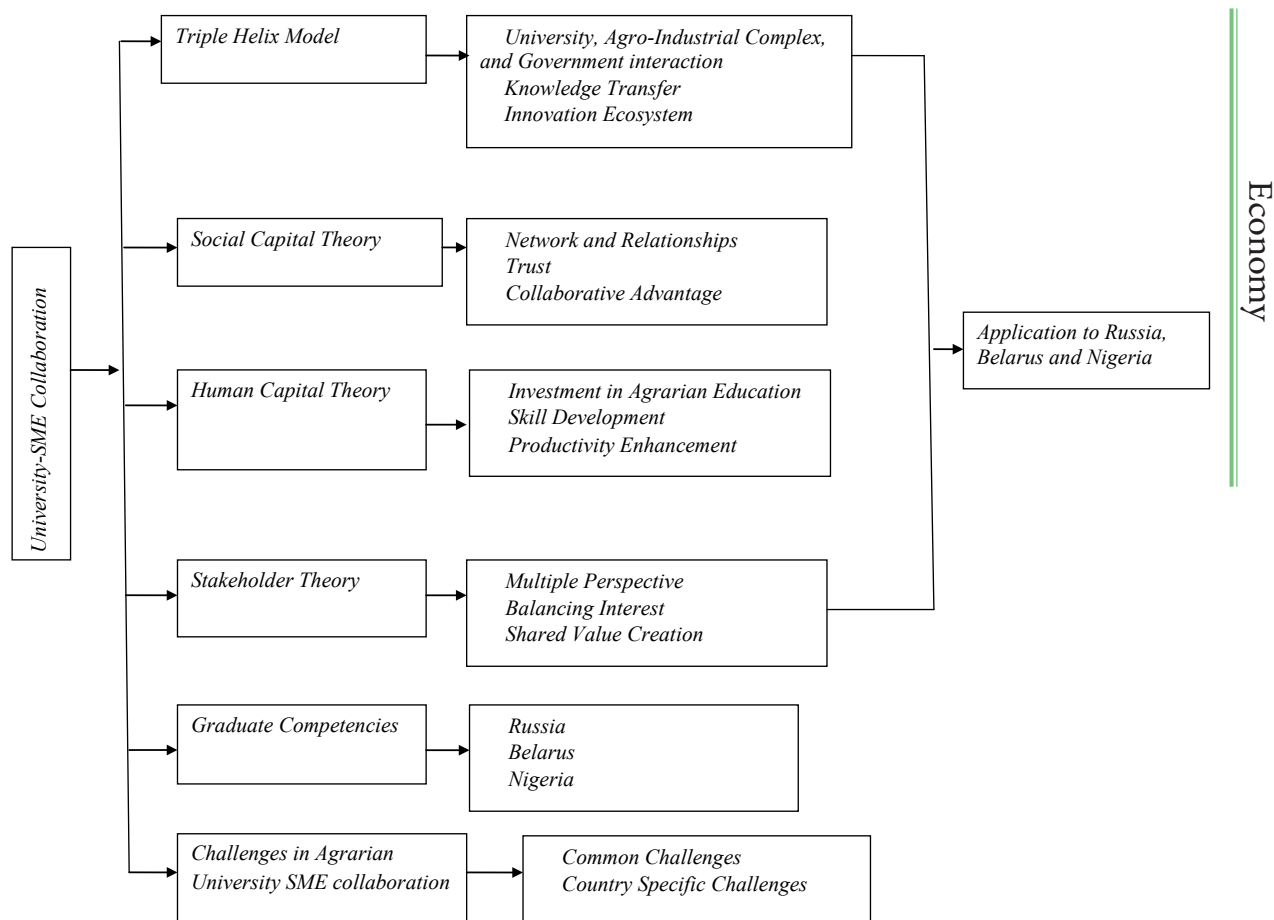
Fig. 1. Conceptual Framework for the study
Source: developed by the authors

As these countries develop their higher education systems and strengthen university-SME collaborations, the Triple Helix model provides a valuable framework for enhancing these interactions, fostering innovation and economic vibrancy in general, and the agricultural and industrial complex in particular.

Social Capital Theory

The Theory of Social Capital, views social ties as a collective resource for obtaining benefits. It emphasizes social capital's value in reducing transaction costs, leading to entrepreneurial success and increased organizational profits [6; 21; 22].

In university-SME collaboration, Social Capital Theory highlights the importance of networks and trust in facilitating knowledge transfer and enhancing graduate employability. Nieves Arranz et al. argue that "creating an active collaboration between the university and the company both in-depth and in breadth is a facilitator of the employment of HEIs graduates" [1].

In Russia, V. G. Lizunkov et al. [9] and M. V. Morozova et al. [19] found employers highly valued team competence, but noted a significant skills gap among graduates.

Belarus is transitioning to a market-oriented economy, with Social Capital Theory gaining traction in university-SME collaboration. Adela García-Aracil et al. [8] identified six key items defining graduate employability in Belarus. However, challenges remain, as Rosa Isusi-Fagoaga et al. [10] point to a lack of attention to entrepreneurial and transversal competencies in Belarusian higher education.

All three countries need to further develop Social Capital Theory in practice to strengthen university-SME relations. This can help bridge the skills gap and enhance graduate employability in the global job market [4; 5; 20].

Human Capital Theory

The Theory of Human Capital is central to social reproduction and economic growth at both macro and micro levels. It posits that investing in education and training leads to increased productivity and economic benefits for individuals and society, underpinning the rationale for university education's role in workforce preparation [21; 22].

In Russia, D. A. Avdeeva's [21] study assessed human capital's (HC) contribution to economic growth from 2000–2021. From 2004–2017, HC accumulation provided about 0.6 percentage points of annual economic growth, decreasing to near zero by 2018–2019. In 2020–2021, HC's contribution became negative (–0.5 percentage points) due to the Covid pandemic's impact on public health [21].

Belarus is reforming its higher education system to improve quality [30] and align with labor market needs [4]. García-Aracil et al. [23] studied employers' perceptions of graduates' employability in Belarus. Isusi-Fagoaga et al. [10] found a lack of attention to entrepreneurial and transversal competencies in Belarusian higher education, suggesting a need for more targeted investment.

In Nigeria, Binuyo et al. [24] found that social innovation dimensions positively affected skill acquisition among university graduates (Adj. $R^2 = 0.254$, F $(4, 510) = 44.826$, $p < 0.05$), highlighting the importance of education innovation and digital innovation in enhancing graduate skills.

It is also important that the effectiveness of the agrarian personnel policy and the positive dynamics of its development are largely determined by the qualitative parameters of human capital. In the study of N. I. Proka [25], the basic directions of investments in the development of the human capital of the agro-industrial complex are considered, where a comparative analysis of the indicators of the state program "Integrated rural development" is taken as a basis. As a result of this author's research, it is shown that the effectiveness of using state support funds for any agro-industrial complex development program depends on a three-level system of socio-economic indicators, which makes it possible to assess the effectiveness of its implementation and the effectiveness of using budget funds.

Thus, these studies demonstrate the need for expanded cooperation between higher education institutions, AIC and the labor market, aligning with Human Capital Theory's emphasis on developing directly applicable skills in the labor market.

Stakeholder Theory

The Stakeholder Theory, applicable to university-SME collaboration, emphasizes considering all parties' interests in the educational process [27; 29]. In Russia, this theory is successfully applied in large organizations and is being explored for universities' "third mission" implementation [15]. A Northwestern Scientific School study compared universities in Russia, Poland, Lithuania, and Sweden, proposing a classification of key university stakeholders and highlighting employers' role [15]. Other Russian researchers have also examined aspects of coordinating employer, university interests [4; 22; 32; 33] as well as customer's ones [19; 28; 30; 31].

In Belarus, as the country transitions to a market-oriented economy, Stakeholder Theory application in university-SME collaboration gains importance. García-Aracil et al. [6] studied employers' perceptions of graduates' employability in Belarus, exemplifying the stakeholder approach.

For Nigeria, C. A. Nwajiuba et al. [7] adopted a stakeholder approach in studying higher education quality and graduate employability, emphasizing the need to consider various stakeholders' perspectives in curriculum design.

As for the application of the theory of stakeholder management in the agro-industrial complex, here, according to the research of R. V. Nuzhdin [26], the theoretical basis has just begun to form.

Thus, the considered studies demonstrate the necessity of reconciling university and business interests, aligning with Stakeholder Theory principles.

Current state of University-SME collaboration
Russia

In Russia, efforts to enhance university-SME collaboration in the agricultural sector have been significantly shaped by the need to modernize agribusiness education and align it with contemporary farming and food production demands. L. Daineko [34] examines how Ural Federal University (UrFU) has implemented innovative approaches to modernize education through online technologies, project-based learning, and creating collaborative spaces between students and business experts. At the same time, it should be noted that similar measures have begun to be implemented at the Ural State Agrarian University. In other words, innovative approaches are being introduced to modernize agricultural education through online technologies, project-based learning on farms and creating a space for collaboration between students and agribusiness experts.

V. Teslenko and R. Melnikov [35] emphasize the importance of developing specialized doctoral programs in agricultural sciences, particularly focusing on training researchers and engineers for high-tech agricultural enterprises. Their proposed industrial PhD model suggests collaboration between universities and agricultural businesses, with research projects directly addressing farming sector needs and joint supervision between academic and agro-industrial experts.

A. S. Kucherov [27] specifically addresses the agricultural sector, outlining strategies to improve cooperation between agricultural universities, rural schools, and agricultural producers to enhance workforce development in regional agro-industrial complexes. However, the systematic study of employer satisfaction with agricultural graduates' competencies remains an emerging field in Russia.

Nigeria

In Nigeria, while university-SME collaboration in agriculture is still developing, there are increasing efforts to bridge this gap. I. Otache [11] investigates how Nigerian educational institutions can better prepare graduates for the agricultural sector, emphasizing the need for agricultural industry experts' involvement in curriculum development. The study particularly highlights the importance of practical agricultural training and exposure to modern farming operations.

C. A. Nwajiuba et al. [7] found significant gaps in collaboration between higher education institutions and agricultural businesses in Nigeria, noting that many institutions lack adequate resources for teaching modern agricultural skills. The authors stress the importance

Экономика

of creating stronger links between agricultural universities, farming businesses, and government agencies to develop more effective agricultural education programs.

The research revealed a particular gap in studies focusing specifically on agricultural university-SME collaboration and employer satisfaction with agricultural graduates' competencies in both countries' literature.

Belarus

In Belarus, efforts to enhance university-SME collaboration are gaining momentum as the country transitions to a more market-oriented economy and align its higher education system with international standards. A. Moemeni et al. [36] describe the EU-funded ERASMUS+ Capacity Building in Higher Education project, which aims to enhance the competencies of ICT specialists and improve the quality of ICT education in Belarusian universities. This project involves collaboration between Belarusian universities, European higher education partners, as well as agro-industrial representatives, demonstrating a multi-stakeholder approach to education reform [51].

A. García-Aracil and R. Isusi-Fagoaga [6] conducted a comprehensive study on employers' perceptions of young higher education graduates' employability in Belarus. Their research, based on a survey of 261 employers, identified 24 competencies associated with obtaining a job after graduation, grouped into five categories: entrepreneurial, leadership, interdisciplinary, cognitive, and adaptability. This study provides valuable insights into the expectations of employers and highlights areas where university-SME collaboration could be strengthened to enhance graduate employability.

However, challenges remain in fully realizing effective university-SME collaboration in Belarus. R. Isusi-Fagoaga et al. [10] found a disconnection between higher education outcomes and societal needs, particularly in terms of entrepreneurial and transversal competencies. This suggests a need for more targeted collaboration between universities and SMEs to better align educational outcomes with labor market demands.

To address these challenges, A. Fedotov et al. [37] emphasize the importance of aligning master-level education in physical sciences with market needs in Belarus. Their study highlights the need for enhancing cooperation between higher education institutions and the labor market, particularly in organizing internships and practical experiences for students. This approach aligns with the efforts seen in Russia and Nigeria to expose students to real-world work situations.

Furthermore, Y. Kalesnik et al. [20] identified several areas for improvement in Belarusian universities, including the development of soft skills competencies for both teachers and students, the introduction of active teaching and learning methods, and the implementation of a student-oriented quality assessment system. These initiatives demonstrate Belarus's commitment to enhancing university-SME collaboration and improving the overall quality of higher education.

At the same time, we have not found studies in relation to agriculture and agricultural universities in the open access literature.

Graduate competencies valued by SMEs in agricultural industrial complex

In Russia, employers in the agro-industrial complex value both technical agricultural skills and soft competencies. T. Kamarova [38] notes a significant shift towards soft skills since 2000 even in traditionally technical agricultural sectors, citing a Harvard University and Stanford Research Institute study showing soft skills contribute 85% to an employee's professional success. V. Lizunkov et al. [39] found agricultural employers highly valued team competence for managing complex farming operations, but revealed a significant gap between expectations and agricultural graduates' competencies. A. Komissarov et al. [40; 41] identified stress resistance, result orientation, agricultural planning, and adherence to agricultural safety protocols as key competencies valued by agribusiness employers.

In Nigeria's agricultural sector, T. Ayodele et al. [42] found high employer expectations for soft skills like responsibility, business administration, stakeholder communication, agricultural business negotiation, and work ethics, with significant skill gaps in areas such as responsibility and agricultural problem-solving. U.C. Okolie et al. [43] found that agricultural entrepreneurship education positively associated with key competencies like agricultural opportunity recognition and creative problem-solving in farming operations. A.O. Binuyo et al. [24] highlighted the importance of social innovation in agricultural skill acquisition.

In Belarus's agro-industrial sector, A. García-Aracil et al. [6] identified 24 competencies valued by agricultural employers, grouped into agricultural entrepreneurship, leadership in farming operations, interdisciplinary agricultural knowledge, cognitive abilities, and adaptability to changing agricultural conditions. Employers prioritize agricultural job-related skills, farmer-stakeholder relationship skills, and agricultural management skills. However, R. Isusi-Fagoaga et al. [10] found a lack of attention to agricultural entrepreneurial and transversal competencies in Belarusian agricultural education.

To address these challenges, Belarus implemented initiatives like the EU-funded ERASMUS+ project [51] to enhance modern agricultural competencies. D. Bylaite-Šalavejiene and A. García-Aracil [50] propose promoting competency-based agricultural education, emphasizing both domain-specific farming skills and transversal competencies. Y. Kalesnik et al. [20] identified areas for improvement in Belarusian universities, including soft skills development for agricultural teachers and students, aligning with trends in Russia and Nigeria.

E.V. Bocharova [28] rightly indicates that ensuring agro-industrial complex competitiveness faces serious concerns due to insufficient SME effectiveness, stemming from both unfavorable socio-economic conditions and inadequate specialist training. In conditions of reduced agricultural employment, professional competence becomes critical for job security. Bocharova [28] developed a system of basic cultural and professional competencies reflecting modern work requirements. However, the study didn't fully explore the relationship between worker competencies and university training programs.

Comparing Russia, Belarus and Nigeria

In Russia, employers value both hard and soft skills, with T. Kamarova [38] noting a shift towards soft skills since 2000. V. Lizunkov et al. [39] found employers highly valued team competence, while A. Komissarov et al. [40] identified stress resistance and result orientation as key competencies.

In Nigeria, T. Ayodele et al. [42] found high employer expectations for soft skills like responsibility and communication. U. C. Okolie et al. [43] linked entrepreneurship education to key competencies like opportunity recognition.

In Belarus, A. García-Aracil et al. [23] identified 24 employer-valued competencies in five categories. However, R. Isusi-Fagoaga et al. [10] found a lack of attention to entrepreneurial and transversal competencies in higher education.

To address these challenges, Belarus implemented initiatives like the EU-funded ERASMUS+ project [35; 51]. D. Bylaite-Šalavejiene and A. García-Aracil [18] propose promoting competency-based education, while Y. Kalesnik et al. [20] identified areas for improvement in Belarusian universities.

Despite the relevance of the stated issues, at the same time, to our great regret, we have to state that we have not found similar studies in relation to the field of agriculture and agricultural universities in the literature available to us.

Methodology

This study employed a mixed-methods approach to assess agrarian university – SME in AIC collaboration and employer satisfaction with graduate competencies in Russia, Belarus, and Nigeria. These countries were selected due to their status as major emerging economies with growing SME sectors and reforming higher education systems [7; 44].

The study population consisted of AIC SME employers and agrarian university students in all three countries. A purposive sampling technique was used [43], with 66 SME representatives sampled in Russia, 40 in Belarus, and 44 in Nigeria.

Primary data was collected through expert surveys from May 2023 to September 2024. The Russian and Belarus employer survey included 46 thematic questions and 10 employer-specific questions, while the Nigerian survey had 22 thematic and 8 employer-specific questions. Student surveys were also conducted in all countries.

Data analysis employed Structural Equation Modeling (SEM) for objective one and Principal Component Analysis (PCA) for objective two. SEM was chosen for its ability to analyze multiple variables simultaneously [43], measure latent constructs [45], test causal relationships [46], and account for measurement error.

Main hypotheses

H1: University-SME collaboration positively influences graduate competencies.

H2: Graduate competencies positively influence employer satisfaction.

H3: University-SME collaboration directly positively influences employer satisfaction.

H4: Innovation level positively influences University-SME collaboration.

H5: Company size positively influences University-SME collaboration.

Secondary hypotheses

H6: There is a positive correlation between University-SME collaboration and innovation level.

H7: There is a positive correlation between graduate competencies and innovation level.

H8: There is a positive correlation between employer satisfaction and company sizes.

Mediation hypotheses

H9: Graduate competencies mediate the relationship between University-SME collaboration and employer satisfaction.

Country-specific hypotheses

H10: The strength of the relationship between University-SME collaboration and graduate competencies will be stronger in Russia compared to Nigeria.

H11: The direct effect of University-SME collaboration on employer satisfaction will be stronger in Nigeria compared to Russia.

Principal component analysis (PCA) is suitable for identifying key graduate competencies valued by AIC SMEs in Russia and Nigeria. It reduces correlated competencies into uncorrelated components, revealing crucial skills sought by employers. PCA synthesizes data into principal components, providing a clear framework for understanding core competencies driving SME hiring decisions [46; 47; 48]. Therefore the hypothesized relationship for the Principal Component Analysis is specified as follows:

Overall structure hypothesis

H12: The graduate competencies valued by AIC SMEs in Russia, Belarus and Nigeria will form a four-component structure, representing distinct but related skill sets.

It is important to note that the Innovation Level refers to the combined measure of an organization's technological advancement, research and development activities, implementation of new processes or prod-

ucts, and digital transformation initiatives, as assessed through a composite score ranging from 0–100 based on employers' self-reported data in the survey. Graduate competencies were measured using a standardized 5-point Likert scale assessment of twelve key attributes (technical skills, problem-solving, critical thinking, digital literacy, communication skills, teamwork, adaptability, innovation mindset, entrepreneurial skills, cross-cultural competence, ethical judgment, and social responsibility) as evaluated by employers through the survey instrument. While employer satisfaction was measured through a composite index combining employers' ratings on a 5-point Likert scale across multiple dimensions including graduates' job performance, skill application, workplace readiness, and contribution to organizational goals in agro-industrial complex.

Results

Table 1 reflects characteristics of innovative and technological companies in Russia and Nigeria. In Russia, small businesses predominate (83 %), while Nigeria shows a more balanced distribution [1]. Belarus demonstrates a similar pattern to Russia, with 78 % small enterprises [39]. Legal structures and gender distributions vary significantly, with Russia and Belarus showing male-dominated business environments and Nigeria displaying more diversity [10; 49].

Belarus's business landscape reflects its economic transition, with growing need for market-oriented competencies in higher education graduates [10]. The ICT in AIC is growing rapidly, necessitating improved dialogue between industry and higher education institutions.

A second survey targeted student youth using an author-designed questionnaire. Students from universities in various Russian, Belarusian, and Nigerian cities participated from May 2023 to September 2024. In Belarus, this aligns with competencies development efforts like the FOSTERC project [4; 50].

Table 1
Characteristics of the first respondents' target audience, %

Indicator	*Russia (N = 66)*	*Belarus (N = 66)*	*Nigeria (N = 40)*
1. Type of business			
Small business	83	78	36.4
Medium business	17	22	27.3
Large business	–	–	22.7
2. Legal form of business			
Limited liability company	52	48	18.2
Individual entrepreneurs	34	38	4.5
Self-employed	8	10	18.2
Other types	6	4	59.1
3. Gender distribution of employers			
Men	69.7	65	31.8
Women	30.3	35	27.3
Prefer not to say	–	–	40.9
4. Company location			
Metropolis (regional center)	72.7	68	31.8
City/District center	22.7	26	22.7
Rural area / countryside	4.6	6	13.6
Other	–	–	31.8
5. Respondent status in the company			
Business owners, founders	71.2	68	13.6
Deputy heads of the company	16.6	19	18.2
Department heads	11.2	12	13.6
Other employees	1.0	1	54.5
6. Annual company income			
Less than 100 million rubles	45.5	48	–
121–800 million rubles	19.7	22	–
N 500,001 – N 1 million	–	–	9.1
N 1 million – N 5 million	–	–	13.6
More than N 5 million	–	–	13.6
Refused to answer / Not available	23.2	20	63.6

Note. Here and below N refers to the total number of respondents.
Source: computed by the authors.

Characteristics of the second target audience of respondents, %

Экономика

Indicator	Russia (N = 66)	Belarus (N = 66)	Nigeria (N = 40)
1. Gender distribution of students			
Men	*44.7*	*46*	*31.8*
Women	*55.3*	*54*	*27.3*
Prefer not to say	*–*	*–*	*40.9*
2. Age distribution of student youth			
16–18	*35.3*	*33*	*15.0*
19–20	*32.9*	*34*	*25.0*
21–22	*19.2*	*20*	*30.0*
23–25	*6.4*	*7*	*20.0*
26–29	*2.4*	*3*	*7.0*
31–35	*1.6*	*2*	*2.0*
36 and older	*2.2*	*1*	*1.0*
3. Source of funding for university education			
Budget/Government support	*48.3*	*50*	*15.0*
Paid by parents	*32.0*	*30*	*40.0*
Self-funded	*10.7*	*12*	*30.0*
Paid by company	*4.8*	*5*	*10.0*
Other sources	*4.2*	*3*	*5.0*
4. Sources of student income			
Scholarship	*43.4*	*45*	*20.0*
Salary	*42.8*	*40*	*35.0*
Money from parents/friends	*62.5*	*60*	*70.0*
Savings	*31.3*	*33*	*25.0*
Rental income	*10.8*	*9*	*5.0*
Pension and social benefits	*0.3*	*0.5*	*1.0*
Other	*53.8*	*50*	*15.0*
5. Distribution of Student Youth by Income			
Level 1 "Underprivileged"	*9.4*	*10*	*15.0*
Level 2 "Low-income"	*16.5*	*18*	*25.0*
Level 3 "Middle-income"	*36.7*	*38*	*40.0*
Level 4 "Well-off"	*26.9*	*25*	*15.0*
Level 5 "Rich"	*10.5*	*9*	*5.0*

* Note. It was possible to select multiple responses.

Source: computed by the authors

Table 2 compares student characteristics in Russia, Belarus, and Nigeria. Russia and Belarus shows a slight gender imbalance favoring women (55.3 % and 54 %), while Nigeria has a more balanced distribution [6]. Russian and Belarusian students are generally younger, with 68.2 % and 67 % aged 16–20 [7; 10].

Funding sources differ significantly. Russian and Belarusian students rely more on government support (48.3 % and 50 %), while Nigerian students depend on parental support (40 %) and self-funding (30 %) This reflects different approaches to higher education funding.

Income sources vary, with Russian and Belarusian students having more diverse options, including scholarships and salaries, while Nigerian students rely heavily on parental support. Income distribution shows a predominant middle-income group in all countries, but Russia and Belarus have a higher percentage of "well-off" students [45].

These findings highlight the need for tailored approaches to enhance graduate employability and university-industry collaboration. For Belarus, recent studies emphasize developing both hard and soft skills to meet labor market demands [10].

Figure 2 illustrates priority differences between employers and students in Russia, Nigeria, and Belarus regarding life and work aspects.

In Russia, major discrepancies exist in "Freedom in various spheres of life" and "Financial well-being", with employers rating these higher [1]. Russian students prioritize "Family and children" and "Health" more.

Nigeria shows significant disparities in "Interesting work" and "Financial well-being", with employers rating these higher. Nigerian students also prioritize "Family and children" and "Health" more [7].
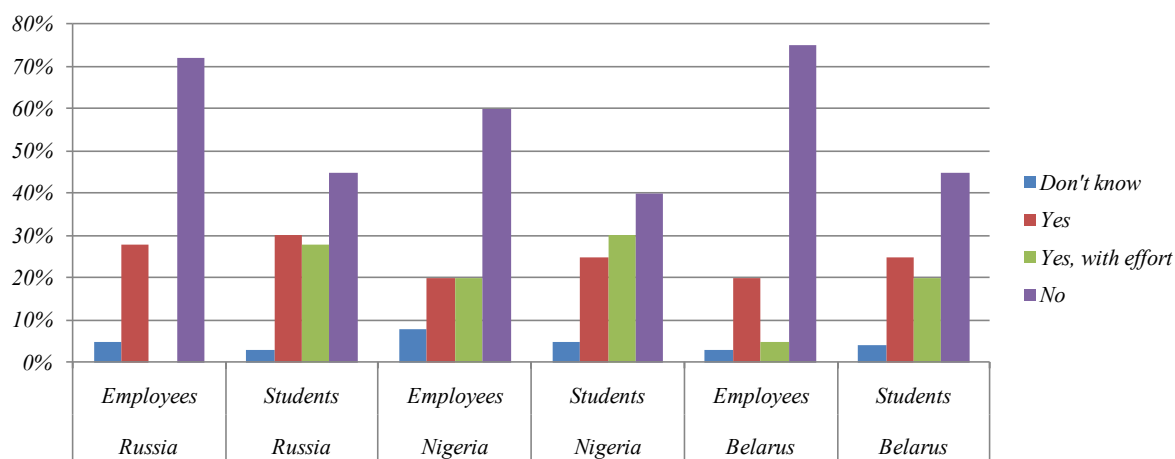
Fig. 2. The answers of the respondents of the first and second target audience to the question: "Is higher education a guarantee of success in life today?", %
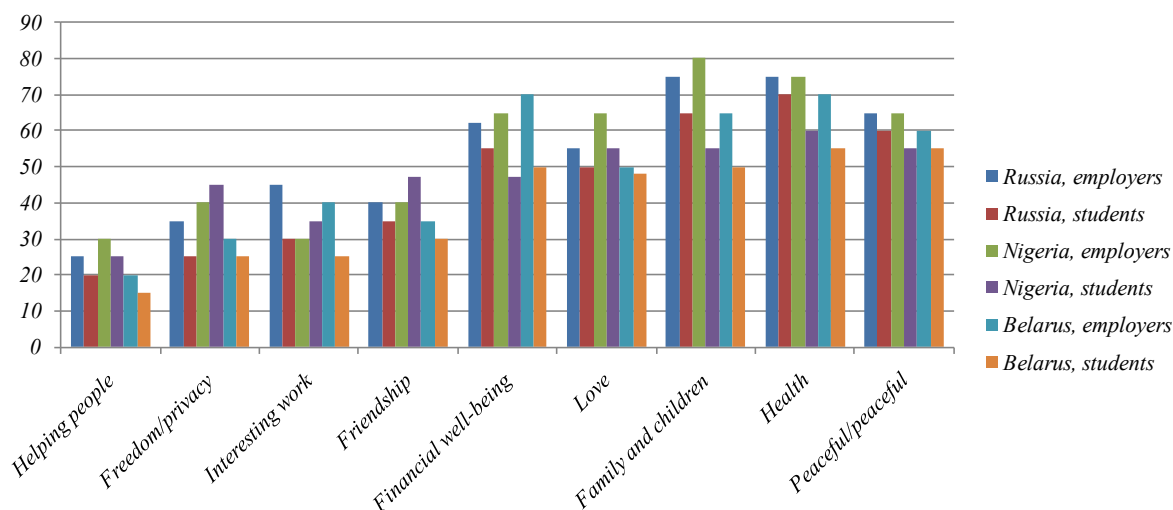*Source: computed by the authors*

Fig. 3. The answers of the respondents of the first and second target audience to the question: "What is the most important thing for you in life?", %
Source: computed by the authors

In Belarus, only 22 % of employers believe higher education guarantees success, compared to 28 % of students. Notably, 71 % of employers and 45 % of students are skeptical about higher education's success guarantee [6; 10].

These misalignments highlight the need for improved communication between higher education institutions, students, and employers.

As noted in our previous study, "*...education is a way of thinking for a person*"; "*...the more multifaceted this way of thinking is, the more vivid the individual's personal and professional life becomes*"; "*…a good higher education is a guarantee of a person's success in life*" [31].

Figure 3 reveals significant differences in perceptions of higher education across Russia, Nigeria, and Belarus, and between students and employers. In Russia, 72 % of employers don't view higher education as a guarantee of success, compared to 45 % of students [1]. Nigeria shows more optimism, with 60 % of employers

and 42 % of students seeing higher education as not guaranteeing success [42]. Belarus presents a similar pattern to Russia, with 80 % of employers and 60 % of students not seeing higher education as a success guarantee [6].

This skepticism points to potential issues in aligning university curricula with labor market needs [41]. For Belarus, R. Isusi-Fagoaga et al. [10] found a lack of attention to entrepreneurial and transversal competencies, suggesting a disconnect between academic training and societal needs. Initiatives like the FOSTERC project aim to address these gaps [51].

Structural Equation Model: University-SME collaboration and employer satisfaction

The structural equation model aligns with the triple helix framework [64], illustrating relationships between university-SME collaboration, graduate competencies, and employer satisfaction in Russia, Nigeria, and Belarus (Figure 4).
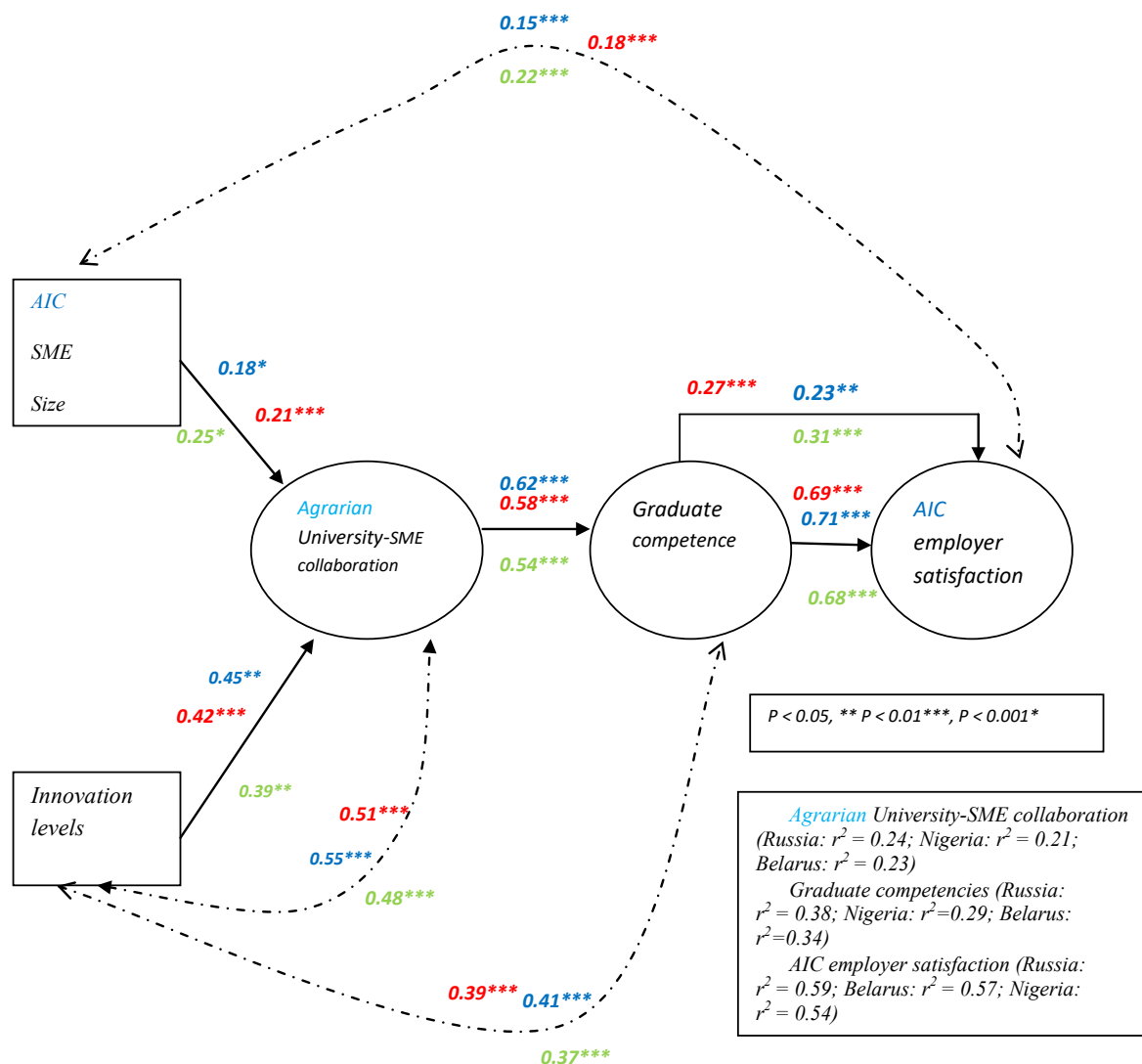
505

Экономика

Fig. 4. SEM path diagram
Note. Coefficients in blue, red and green are for Russia, Belarus and Nigeria respectively
Source: computed by the authors

Index	Russia	Nigeria	Belarus
Chi-square/df	2.34	2.87	2.61
CFI	0.942	0.923	0.933
TLI	0.935	0.911	0.924
RMSEA	0.056	0.068	0.062
SRMR	0.043	0.052	0.048

Source: computed by the authors.

University-SME collaboration strongly influences graduate competencies across all countries [$\beta = 0.62$ for Russia, 0.54 for Nigeria, 0.58 for Belarus], supporting research on partnerships enhancing employability [1]. Graduate competencies significantly impact employer satisfaction [$\beta = 0.71$ for Russia, 0.68 for Nigeria, 0.69 for Belarus] (Table 4), aligning with studies on employability skills meeting employer expectations [8].

Innovation level moderately affects university-SME collaboration [$\beta = 0.45$ for Russia, 0.39 for Nige-

ria, 0.42 for Belarus], consistent with the Triple Helix Model. Company size has a lesser influence [$\beta = 0.18$ for Russia, 0.25 for Nigeria, 0.21 for Belarus].

The model fit indices (Table 3) indicate acceptable fit across countries. Latent variable correlations (Table 5) support the connection between partnerships and innovation.

For Belarus, findings align with recent research highlighting the need for higher education reforms and quality improvements [10].

Table 4
Path coefficients

Path	Russia (β)	Nigeria (β)	Belarus (β)
University-SME collaboration → graduate competencies	0.62***	0.54***	0.58***
Graduate competencies → employer satisfaction	0.71***	0.68***	0.69***
University-SME collaboration → employer satisfaction	0.23**	0.31***	0.27**
Innovation level → University-SME collaboration	0.45***	0.39***	0.42***
Company Size → University-SME collaboration	0.18*	0.25**	0.21*

*Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*
Source: computed by the authors.

Table 5
Latent variable correlations

Variables	Russia	Nigeria	Belarus
University-SME collaboration ↔ innovation level	0.53***	0.48***	0.51***
Graduate competencies ↔ innovation level	0.41***	0.37***	0.39***
Employer satisfaction ↔ company size	0.15*	0.22**	0.18*

*Note. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.*
Source: computed by the authors.

Table 6
R-squared values

Variable	Russia	Nigeria	Belarus
Graduate competencies	0.38	0.29	0.34
Employer satisfaction	0.59	0.54	0.57
University-SME collaboration	0.24	0.21	0.23

Source: computed by the authors.

Principal Component Analysis: graduate competencies valued by SMEs

The Principal Component Analysis (PCA) of graduate competencies valued by SMEs in Russia, Nigeria, and Belarus, as presented in Tables 7 and 8, reveals four principal components explaining over 75 % of the variance in all three countries, indicating a robust factor structure.

The first component, "Technical and Analytical Skills", accounts for the largest proportion of variance (32.08 % in Russia, 30.17 % in Nigeria, 31.08 % in Belarus). It encompasses technical skills, problem-solving, critical thinking, and digital literacy, with high factor loadings (0.71–0.82) [1; 6]. This aligns with the growing demand for graduates with strong analytical and technical capabilities [52].

The second component, "Interpersonal Skills", explains about 20 % of the variance, comprising communication skills, teamwork, and adaptability (factor loadings 0.73–0.81) [8].

"Innovation and Global Mindset", the third component, accounts for approximately 15 % of the variance, including innovation mindset, entrepreneurial skills, and cross-cultural competence (factor loadings 0.71–0.79) [12].

The fourth component, "Ethical and Social Awareness", explains about 10 % of the variance, comprising ethical judgment and social responsibility (factor loadings 0.80–0.85).

The similarity in factor structures across countries suggests a convergence in competencies valued by SMEs across different contexts, aligning with human capital theory. However, the emphasis on interpersonal skills and cross-cultural competence underscores the role of social capital theory in graduate employability [1].

Discussion and Conclusion

The findings reveal significant opportunities and challenges in enhancing agrarian university – AIC SME collaboration through employer satisfaction studies in Russia, Nigeria, and Belarus. All three countries face issues aligning higher education outcomes with labor market needs, though specific contexts differ.

In Russia, initiatives like Project 5-100 have increased university-industry cooperation [3]. However, gaps remain between employer expectations and graduate competencies, as Lizunkov V. et al. [9] found low to average team competence among graduates despite high employer valuation.

Nigeria presents more fundamental challenges, with Nwajiuba C. A. et al. [7] highlighting minimal collaboration between higher education institutions and agro-industrial business, and lacking infrastructure to teach employability skills effectively.

Belarus, transitioning to a market economy, shows a disconnection between higher education outcomes and societal needs, particularly in entrepreneurial and transversal competencies [10].

Structural equation modeling results underscore the importance of agrarian university and AIC SME collaboration in all three countries for enhancing graduate competencies and employer satisfaction. The strong positive effect of collaboration on graduate competencies [β = 0.62 for Russia, β = 0.54 for Nigeria, β = 0.58 for Belarus] aligns with research showing university and agro-industrial partnerships can improve graduate employability [1].

Экономика

Component	Russia			Nigeria			Belarus		
	Eigen value	% of Variance	Cumulative %	Eigen value	% of Variance	Cumulative %	Eigen value	% of Variance	Cumulative %
1	3.85	32.08	32.08	3.62	30.17	30.17	3.73	31.08	31.08
2	2.41	20.08	52.16	2.53	21.08	51.25	2.47	20.58	51.66
3	1.76	14.67	66.83	1.89	15.75	67.00	1.82	15.17	66.83
4	1.12	9.33	76.16	1.24	10.33	77.33	1.18	9.83	76.66

Source: computed by the authors.

Table 8
Rotated Component Matrix

Competency	Russia				Nigeria				Belarus			
	PC1	PC2	PC3	PC4	PC1	PC2	PC3	PC4	PC1	PC2	PC3	PC4
Technical skills	**0.82**	0.14	0.22	0.11	**0.78**	0.19	0.25	0.15	**0.80**	0.16	0.23	0.13
Problem-solving	**0.79**	0.28	0.18	0.09	**0.75**	0.31	0.22	0.12	**0.77**	0.29	0.20	0.10
Critical thinking	**0.77**	0.32	0.15	0.13	**0.72**	0.35	0.18	0.17	**0.74**	0.33	0.16	0.15
Digital literacy	**0.75**	0.21	0.29	0.18	**0.71**	0.25	0.33	0.20	**0.73**	0.23	0.31	0.19
Communication skills	0.23	**0.81**	0.19	0.15	0.28	**0.79**	0.22	0.18	0.25	**0.80**	0.20	0.16
Teamwork	0.25	**0.78**	0.22	0.11	0.30	**0.76**	0.25	0.14	0.27	**0.77**	0.23	0.12
Adaptability	0.31	**0.76**	0.25	0.14	0.35	**0.73**	0.28	0.17	0.33	**0.74**	0.26	0.15
Innovation mindset	0.27	0.23	**0.79**	0.18	0.31	0.27	**0.75**	0.21	0.29	0.25	**0.77**	0.19
Entrepreneurial skills	0.24	0.19	**0.77**	0.22	0.28	0.23	**0.73**	0.25	0.26	0.21	**0.75**	0.23
Cross-cultural competence	0.21	0.25	**0.75**	0.24	0.25	0.29	**0.71**	0.27	0.23	0.27	**0.73**	0.25
Ethical judgment	0.17	0.13	0.20	**0.85**	0.21	0.17	0.24	**0.82**	0.19	0.15	0.22	**0.83**
Social responsibility	0.14	0.16	0.25	**0.83**	0.18	0.20	0.28	**0.80**	0.16	0.18	0.26	**0.81**

Note. Component labels: PC1: Technical and Analytical Skills, PC2: Interpersonal Skills, PC3: Innovation and Global Mindset, PC4: Ethical and Social Awaren.

Source: computed by the authors.

Principal component analysis reveals similarities in valued graduate competencies across the countries, with technical/analytical skills, interpersonal skills, innovation mindset, and ethical awareness emerging as key components. This convergence suggests some universal employer expectations, aligning with human capital theory.

Ensuring food security has always been and is the most important task of the socio-economic development of any country. Agricultural universities in cooperation with representatives of the agricultural business play a special role in maintaining a balance of interests in this context. That is why the study of partnerships between universities and SMEs in various economic contexts is extremely important, especially in the field of agriculture.

Our study of agrarian universities and SME collaboration in the AIC across Russia, Belarus, and Nigeria reveals critical insights for improving sectoral higher education outcomes and economic development. The research addresses a significant gap in understanding how these partnerships influence graduate competencies and employer satisfaction in different economic contexts.

Key findings demonstrate that sectoral university-SME collaboration significantly impacts graduate competencies (β = 0.62 for Russia, β = 0.54 for Nigeria, β = 0.58 for Belarus) and employer satisfaction (β = 0.71 for Russia, β = 0.68 for Nigeria, β = 0.69 for Belarus). The study identified four crucial competency components: technical/analytical skills, interpersonal skills, innovation mindset, and ethical awareness, explaining over 75 % of variance across all three countries.

The impact of this research extends beyond academia, offering practical insights for policymakers and educational institutions. The findings support the relevance of the Triple Helix Model, Human Capital Theory, and Social Capital Theory in understanding university-SME collaborations in the agricultural sector.

Future research should focus on developing targeted interventions to enhance collaboration effectiveness in different national contexts, particularly in agricultural education. Additionally, longitudinal studies examining the long-term impact of university-SME partnerships on agricultural sector development and investigation of digital competencies in agricultural education would be valuable areas for further exploration.

Based on the research findings, here are five practical recommendations:

1. Establish structured collaboration frameworks. Universities and agricultural SMEs should develop formal, systematic partnership programs with clear objectives, timelines, and responsibilities. This should include regular agro-industrial advisory meetings, structured internship programs, and joint research

projects focused on solving real agricultural business challenges. This recommendation is supported by the strong correlation between university-SME collaboration and graduate competencies ($\beta > 0.54$ across all three countries).

2. Redesign agricultural curriculum with AIC input in educational institutions. Should regularly update their agricultural curricula by incorporating direct input from SME employers, focusing on the four key competency areas identified in the research: technical/analytical skills, interpersonal skills, innovation mindset, and ethical awareness. This should include practical, hands-on training modules designed in partnership with agricultural businesses.

3. Create joint innovation platforms. Develop shared physical and digital spaces where universities and agricultural SMEs can collaborate on innovation projects. This recommendation is based on the study's finding that innovation level significantly influences university-SME collaboration ($\beta = 0.45$ Russia, $\beta = 0.39$ Nigeria, $\beta = 0.42$ Belarus) and should include technology transfer offices and agricultural innovation hubs.

4. Implement competency-based assessment systems. Develop assessment methods that evaluate students based on the specific competencies valued by agricultural employers, as identified in the PCA analysis. These assessments should incorporate practical demonstrations of skills and be validated by agro-industrial professionals to ensure alignment with market needs.

5. Establish regional agricultural knowledge networks. Create formal networks connecting universities, agricultural SMEs, and government agencies to facilitate knowledge exchange, resource sharing, and policy development. This recommendation is supported by the study's theoretical framework, particularly the Triple Helix Model, and should focus on creating sustainable, long-term partnerships that benefit all stakeholders.

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