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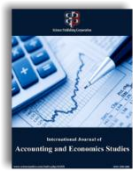

Structural, Institutional, and Innovation Barriers to the sustainable development of small and medium-sized enterprises in Azerbaijan's agribusiness sector: policy implications for diversification and food security

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Abstract

This study provides a comprehensive analysis of the multidimensional challenges constraining the development of small and medium-sized enterprises (SMEs) in Azerbaijan's agribusiness sector. Through an integrated economic and institutional lens, it identifies structural, financial, and innovation-related barriers that hinder the sector's ability to achieve sustainable growth. Emphasizing the strategic role of agribusiness in ensuring food security and fostering rural employment, the research examines both the macroeconomic environment and firm-level dynamics influencing SME performance. The paper evaluates the production potential of agribusiness enterprises and investigates the eco-nomic trends shaping their development trajectory. Using comparative macroeconomic indicators and Excel-based regression analysis, the study assesses the elasticity of key production factors and their relative influence on entrepreneurial output. The findings underscore the necessity of aligning national support mechanisms with global innovation practices, enhancing financial accessibility, and improving the institutional ecosystem for agribusiness entrepreneurship. Ultimately, the study formulates a set of policy-oriented recommendations aimed at strengthening the competitiveness of Azerbaijan's agrarian SMEs, reducing import dependency, and reinforcing the resilience of the national food system.

Keywords: *Azerbaijan; Agrarian Economy; Agribusiness; Small and Medium-Sized Enterprises; Economic Diversification; Food Security; Innovation Policy.*

1. Introduction

In the contemporary phase of Azerbaijan's socio-economic transformation, one of the foremost strategic imperatives is the modernization of its development model in line with the requirements of the Fourth Industrial Revolution. This transformation necessitates not only technological adaptation but also the establishment of an enabling institutional environment that promotes entrepreneurship, innovation, and sustainable competition. Within this framework, the agribusiness sector occupies a pivotal role due to its dual function in ensuring food security and stimulating regional economic diversification.

At the core of the country's economic agenda lies the consistent development of small and medium-sized enterprises (SMEs), which represent the backbone of a resilient and diversified economy. SMEs serve as catalysts for employment generation, innovation diffusion, and rural revitalization. Despite a series of structural reforms and state programs designed to stimulate entrepreneurship, the contribution of SMEs to Azerbaijan's gross domestic product remains modest compared to global benchmarks. The government's long-term vision—anchored in the principles of inclusive growth—recognizes the necessity of intensifying efforts to improve SME competitiveness, enhance production efficiency, and expand market access.

The post-pandemic global economic landscape and shifting geopolitical realities have further exposed the vulnerabilities of resource-dependent economies. For Azerbaijan, this underscores the urgency of diversifying beyond the oil and gas sectors by leveraging agribusiness as a driver of sustainable development. As Aliyev (2012) and Valiyeva (2019) note, SMEs in agriculture not only provide economic resilience but also contribute to national self-sufficiency, poverty reduction, and rural stabilization.

However, the structural and institutional challenges facing Azerbaijani SMEs—ranging from inadequate access to finance and technology to limited innovation capacity—continue to impede the sector's full potential (Ismayilov et al., 2022; Boland & Çakır, 2018). Although state programs and incentive mechanisms have been introduced to foster entrepreneurship, their practical implementation and alignment with contemporary innovation ecosystems remain insufficient. Many targeted development projects and grant schemes lack

the necessary integration with digitalization and sustainable agricultural innovation strategies, which are vital for transitioning to a knowledge-based rural economy.

Given these realities, the present study seeks to (1) analyze the structural and economic determinants of SME development in Azerbaijan's agribusiness sector, (2) evaluate the macroeconomic trends influencing production and employment, (3) quantify the impact of institutional and financial factors on output elasticity, and (4) propose comprehensive policy interventions for the sustainable growth of agribusiness enterprises. By combining descriptive and econometric methods, the study offers evidence-based insights that may inform strategic policymaking and enhance the contribution of SMEs to Azerbaijan's economic diversification agenda.

2. Review of Literature

Current literature highlights that the ability of emerging economy agribusiness-related small and medium-sized enterprises (SMEs) to combine innovation, institutional flexibility, and technological adaptation has become more critical to their sustainable development. Within the last ten years, the research on the performance of SMEs has evolved to be more multidimensional and based on environmental sustainability, digital transformation, and policy coherence rather than being dominated by financial-based perspectives. Empirical studies by Awuni et al. (2025) and Khan (2024) suggest agribusiness competitiveness is now determined by innovation ecosystems linking research institutions, technology providers, and market intermediaries, whereas Rambe & Khaola (2022) argue digitalisation via precision agriculture, blockchain-traceability, and smart logistics is a decisive factor in determining agri-value chain efficiency and transparency.

In South Caucasus and Central Asia, empirical studies by Kenzhetayeva (2025; Baitursunov et al., 2025) have found that institutional weakness, financial exclusion, and poor innovation infrastructure are still the main bottlenecks to SME development. In making comparative analyses of Turkey, Kazakhstan, and Georgia, specific policy incentives, improved rural credit programmes, and technology-based incubators significantly boost the productivity and export potential of the entrepreneurs. As part of this more general discussion, the agribusiness industry in Azerbaijan portrays both commonalities and some unique issues, especially about balancing the fast diversification of the economy and the sustainable change of the food system (Ismayilova & Hajiyeva, 2024).

The literature also highlights the challenge of ensuring the policy design of SMEs is in line with socio-environmental requirements, such as resource efficiency, climate resilience, and circular-economy practices. Sustainable competitiveness, as it is noted by Forés (2025), is becoming more dependent on the ability of firms to incorporate ecological factors in production and processing choices. In its turn, the reshaping of structural, institutional, and innovation obstacles to agrarian SMEs in Azerbaijan not only adds value to the regional economic theory but also contributes to the general idea of how agribusiness serves as one of the foundations of inclusive and robust economic development (Akuriba et al., 2021).

3. Methods and Approaches

The development of small and medium-sized enterprises (SMEs) in Azerbaijan's agribusiness sector is shaped by a complex interplay of economic, institutional, and technological factors. To analyze these dimensions, this study employed a systematic research design combining theoretical analysis, hypothesis formulation, and empirical validation through descriptive and comparative economic data. The methodology emphasizes the integration of conceptual frameworks with applied research tools to identify both the structural barriers and the policy levers influencing SME growth in the agrarian economy.

A core component of this study involved a diagnostic evaluation of state support mechanisms, innovation infrastructure, and digital transformation tools, aiming to determine their effectiveness in fostering SME competitiveness. To ensure analytical rigor, the study was guided by a set of working hypotheses, each addressing a key aspect of agribusiness development under global and national economic constraints.

Research Hypotheses

H1. In response to ongoing global challenges, there is a critical need to adopt modern and multifunctional mechanisms for SME development to ensure the efficient use of raw materials, align agricultural production with contemporary technological standards, and promote diversification in agribusiness growth.

H2. Establishing a robust theoretical and institutional foundation for entrepreneurship in the agrarian sector is essential. Identifying the determinants of SME expansion and assessing their impact on overall agricultural development will enhance understanding of agribusiness dynamics.

H3. SMEs significantly contribute to the competitiveness of regional economies. Analyzing structural transformations within agriculture and their impact on economic efficiency will clarify the role of SMEs in regional socio-economic development.

H4. Evaluating the current production structure, growth prospects, and key performance indicators of SMEs will allow for a comprehensive assessment of their contribution to meeting domestic demand for agricultural products.

H5. The formation of effective logistics networks, innovative infrastructure, and cluster systems is crucial for SME sustainability. These factors directly influence labor market structure and determine the investment attractiveness of the agribusiness sector.

H6. Enhancing the economic efficiency and market accessibility of SMEs should be a policy priority. Expanding their export potential and financial sustainability will strengthen their position within the national economy and global value chains.

H7. Addressing emerging global and regional challenges requires a comprehensive strategy for SME development that ensures integration into international markets and the adoption of advanced digital and innovative mechanisms.

This hypothesis-driven approach enabled the study to establish logical connections between empirical observations and theoretical assumptions, ensuring both depth of analysis and policy relevance. Statistical validation was performed using secondary macroeconomic data obtained from the State Statistics Committee of the Republic of Azerbaijan, complemented by institutional and sectoral reports from the Ministry of Agriculture and international databases such as FAO and the World Bank.

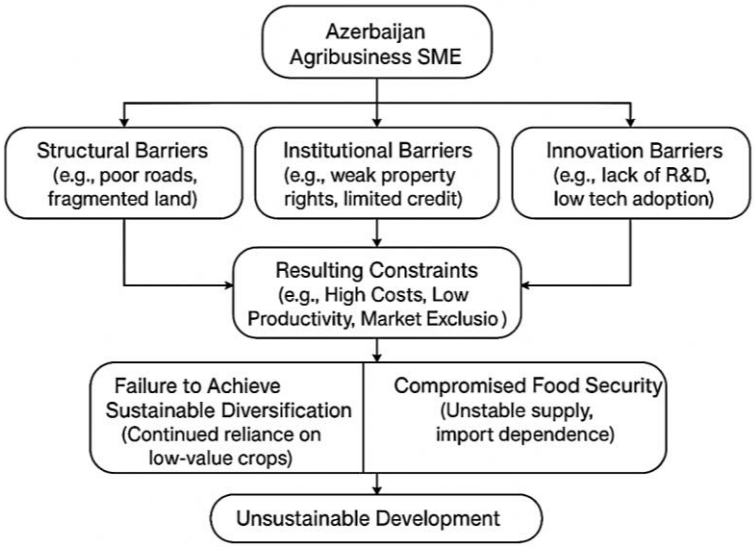

Fig. 1: Flowchart of Structural, Institutional, and Innovation Barriers Affecting Sustainable Development of Agribusiness SMEs in Azerbaijan.

4. Results and Materials

4.1. Post-independence agrarian transformation

Following Azerbaijan's independence, the agrarian sector underwent fundamental reforms aimed at transitioning from a centralized command economy to a market-oriented system. Comprehensive state policies were implemented to modernize rural infrastructure, including the construction of bridges, irrigation systems, and agricultural service facilities. Subsidy programs were established to support agricultural producers, and farmers were provided with preferential access to machinery and fertilizers. Presently, more than 30 distinct subsidy mechanisms are in operation, facilitating productivity growth and sectoral modernization.

Government interventions that previously constrained entrepreneurial activity were significantly reduced, while agricultural producers were granted extensive tax exemptions. The suspension of redundant inspections by various state agencies and the introduction of targeted support programs further stimulated rural entrepreneurship. The establishment of regional logistics centers and cold-storage facilities contributed to supply chain efficiency and improved access to both domestic and export markets.

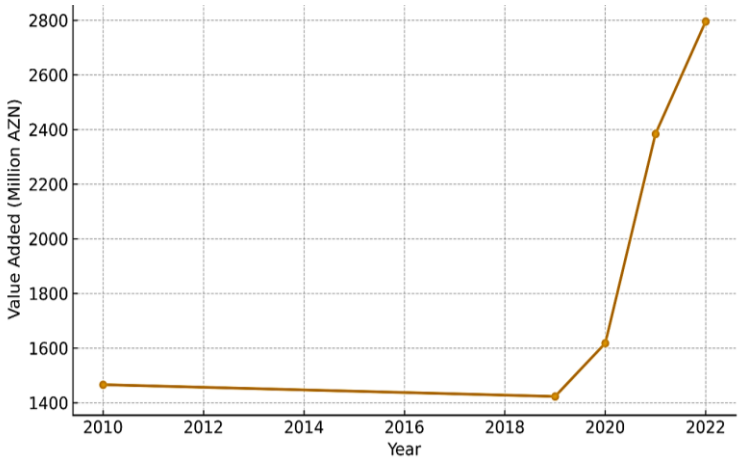

Fig. 2: Trend in SME Value Added (2010-2022).

4.2. Expansion of productive capacity and diversification

Under contemporary economic conditions, Azerbaijan's production potential has expanded considerably, with growing capacity to produce competitive agricultural goods. A landmark development in recent years has been the restoration of post-conflict territories, creating new opportunities for agricultural and agribusiness investments. The diversification of production activities in these territories has reinforced national economic resilience and reduced dependence on the hydrocarbon sector.

The government's strategic orientation toward non-oil economic diversification has elevated agribusiness as a key driver of rural development and national food security. This policy shift has fostered institutional reforms promoting entrepreneurship as a core pillar of the market economy (Huseyn, Shalbuzov & Cafarov, 2024). Modernization of agricultural production processes through technological innovation and digital transformation has become an integral component of Azerbaijan's economic strategy.

4.3. Institutional and structural development

Agribusiness functions as a system of interdependent relationships that link agricultural production, processing industries, and service organizations. The deepening integration of these sectors has enhanced value-chain efficiency, improved product quality, and reduced

post-harvest losses. According to Aliyev et al. (2022), this inter-sectoral coordination facilitates the production of high-quality organic food products, thereby supporting sustainable food supply chains and domestic food security.
The establishment of cooperative enterprises and entrepreneurial clusters has been promoted as an optimal model for SME collaboration, although the number of cooperatives has declined substantially over the past two decades. As of 2019, only 38 cooperatives remained active, compared to 250 in 2000—a sixfold reduction. However, recent years have shown modest recovery across several enterprise categories, indicating renewed policy attention toward cooperative structures and public–private partnerships.

4.4. Statistical dynamics of agrarian enterprises

Empirical data from the State Statistics Committee of the Republic of Azerbaijan (SSCRA) reveal significant structural changes in the composition of agrarian enterprises over the past two decades (see Table 1).

Year	Total Enterprises	Agricultural Enterprises	Service Organizations	Government Enterprises	Collective Farms	Cooperatives	Other Private Organizations	Individual Entrepreneurs
2000	2,910	2,653	408	2	250	1,993	257	3,248
2005	2,506	2,182	303	2	164	1,713	324	2,681
2010	2,336	1,825	217	2	73	1,533	511	2,618
2015	1,875	1,695	180	2	49	1,464	231	1,534
2020	1,085	1,096	113	2	33	955	218	804
2022	2,422	1,259	113	2	33	1,071	219	819

Source: Compiled by the author based on data from the State Statistics Committee of the Republic of Azerbaijan (www.stat.gov.az).

The data indicate a 66% decline in agricultural enterprises between 2000 and 2021, alongside a 72% reduction in individual farms. This contraction reflects the structural transformation of the agrarian economy and the consolidation of production entities. Despite these declines, recent growth in 2021–2022 suggests a gradual resurgence driven by renewed state attention to SME revitalization.

4.5. Economic performance indicators

The overall number of small business entities across all sectors reached 186,898 in 2010, with notable fluctuations in subsequent years. By 2022, the average nominal wage in small enterprises had increased by 89.6%, while value-added output grew by 90.2% and investments in fixed capital by 96.3% compared to 2010 levels. These improvements signify enhanced productivity and social efficiency within the SME sector, reinforcing its strategic role in Azerbaijan's socio-economic transformation.

4.6. Summary of findings

The findings confirm that Azerbaijan's agribusiness sector—dominated by SMEs—has undergone substantial transformation characterized by institutional reform, infrastructural development, and policy-driven diversification. Nevertheless, persistent constraints remain in access to finance, technology adoption, and cooperative management structures. The success of ongoing reforms will depend on further strengthening innovation ecosystems, enhancing export competitiveness, and promoting digital integration in rural enterprise management.

5. Key Macroeconomic Indicators and Analysis of SME Performance in Azerbaijan

5.1. Statistical overview

Table 2: Key Macroeconomic Indicators of Small Business Entities in the Republic of Azerbaijan

Indicators	2010	2019	2020	2021	2022	% change (2022 vs 2010)
Value added (million manats)	1,466.2	1,423.2	1,617.9	2,384.3	2,796.1	190.2
Average annual number of employees (thousand persons)	109.0	85.1	92.1	102.2	104.8	96.1
Average monthly nominal wage (manat)	303.5	437.0	533.8	528.2	575.6	189.6
Investments in fixed capital (million manats)	486.5	494.2	380.4	892.7	955.1	196.3

Source: State Statistical Committee of the Republic of Azerbaijan (SSCRA), www.stat.gov.az. Compiled by the author.

5.2. Economic trends and sectoral dynamics

One of the central objectives of Azerbaijan's current economic policy is to expand and enhance the performance of small and medium-sized enterprises (SMEs) in production sectors characterized by high technological and innovation potential. However, available data primarily emphasize small enterprises due to the limited statistical visibility of medium-sized businesses, particularly within the agricultural sector. This constraint hampers a comprehensive analytical evaluation of SME performance. Presently, approximately 90% of agribusiness enterprises in Azerbaijan fall under the small business category, while the representation of medium-sized enterprises remains relatively limited (Bainov, 2018). Nevertheless, many of the economic trends observed among small enterprises can, to a significant extent, be extrapolated to medium-sized entities (Siropolis, 2014).
Ensuring sustainable growth within the non-oil and gas sector has become a national priority, with economic diversification serving as the cornerstone of Azerbaijan's development strategy. The most promising areas for SME engagement—based on labor intensity and economic potential—include agriculture, tourism, and construction. However, the state's fiscal resources alone are insufficient to ensure the large-scale modernization of these sectors. Consequently, foreign direct investment (FDI), particularly from transnational corporations (TNCs), has emerged as an essential driver of growth. Partnerships between SMEs and TNCs foster innovation diffusion, supply-chain integration, and access to international markets, thereby enhancing SME competitiveness and export capacity.
Despite notable progress, the overall contribution of small businesses to Azerbaijan's GDP remains modest compared with global benchmarks. Over the past five years, the share of small enterprises in GDP has averaged around 10%. While investments in fixed capital by small businesses increased by approximately 260 million AZN (153 million USD) between 2013 and 2022, their contribution to the

national investment volume remains at only 4.2%. Employment trends mirror this pattern: in 2010, small enterprises employed 93,200 individuals (2.7% of total wage employment), which rose to 104,000 (4.9%) by 2022.

A persistent challenge, however, is that many entrepreneurs continue to prefer operating as sole proprietors rather than registering as legal entities. Although such activity contributes to market flexibility, it limits scalability and access to formal financing. Enterprises registered as legal entities are generally regarded as more reliable by both financial institutions and corporate partners (Amrahov, 2014). Accordingly, the government has initiated measures to increase the number of registered enterprises, aiming to create a more transparent, formalized, and sustainable business environment.

5.3. Food security and agribusiness development

The growth of SMEs in the agrarian sector has made a measurable contribution to food self-sufficiency and the stability of the domestic consumer market. The development of SMEs is therefore inseparable from the achievement of national food security goals (Guliyev, 2020). The government has launched a series of targeted state programs and fiscal incentives to improve business conditions and attract investment in agriculture. However, persistent infrastructural deficiencies—including inadequate logistics, storage, and packaging systems—continue to hinder efficiency (Gold, 2024).

Empirical studies indicate that between 5% and 15% of annual fruit and vegetable output is lost due to inefficiencies in harvesting, transport, and supply chains. As Ibrahimov (2010) argues, private entrepreneurship alone cannot overcome these systemic deficiencies; public-sector intervention through infrastructure investment and policy coordination remains essential. This implies that economic governance in agriculture should aim to strengthen the competitiveness of agribusiness enterprises through public–private partnerships, market-oriented innovation, and enhanced regulatory oversight.

SMEs also play a strategic role in linking agriculture with the industrial sector, particularly in supplying raw materials to food and light industries. Such intersectoral linkages foster industrial diversification and amplify the multiplier effect of agribusiness activities on overall economic growth (Huseyn, Huseynov & Museyibov, 2020). Addressing existing gaps requires the adoption of advanced technologies, such as digital farming systems, the Internet of Things (IoT), and artificial intelligence-based analytics, to optimize production efficiency and supply-chain management (Klapper, 2017).

5.4. Global experience and innovation imperatives

A comparative review of international experience—particularly in emerging economies—demonstrates that agricultural innovation is central to post-crisis recovery and competitiveness. Over the past two decades, global trends have underscored that financial constraints, outdated production infrastructure, and inefficient management practices remain the primary impediments to agricultural modernization. Studies by Bigliardi, Ferraro, Filippelli, and Galati (2020) reveal that weak innovation diffusion mechanisms in production systems exacerbate inefficiency and undermine enterprise competitiveness. This is particularly relevant for Azerbaijan, where limited technological adaptation continues to affect both productivity and cost-efficiency in the agricultural value chain.

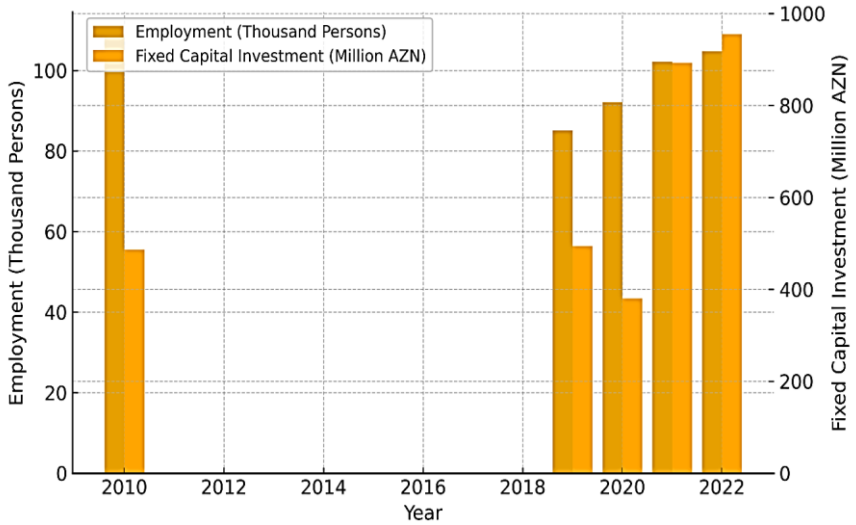

Fig. 3: Comparison of Employment and Fixed Capital Investment (2010-2022).

The insufficient application of innovations in production processes and the lack of structured innovation ecosystems hinder the capacity of rural enterprises to meet global market standards. Consequently, fostering knowledge transfer mechanisms, research-industry collaboration, and innovation-friendly financing instruments are crucial to reversing the degradation of entrepreneurial performance in the agrarian economy.

5.5. The strategic role of agribusiness and agro-processing

Agribusiness and its processing industry constitute the core of Azerbaijan's food supply system, ensuring both market stability and the structural transformation of agriculture. The processing of agricultural raw materials contributes to price stabilization, value addition, and product diversification. For instance, a single raw material such as milk or tomatoes can yield multiple processed outputs—powdered milk, pasteurized milk, tomato paste, and juices—thus broadening consumer choice and increasing market resilience (Abdullayev, K., et.al., 2025).

The agribusiness processing industry also stimulates demand for auxiliary services, including logistics, packaging, marketing, and insurance, thereby generating employment and expanding the service economy. Moreover, as income levels rise and consumption patterns

evolve, the demand for ready-to-eat and packaged food products grows—creating new employment opportunities, especially for women, and accelerating socio-economic inclusion in rural areas (Najafov, 2025).

5.6. Resource allocation and consumption patterns

The allocation of limited production resources among alternative uses does not always align private profit motives with broader social welfare. In Azerbaijan, this misalignment manifests in uneven regional investments and underdeveloped infrastructure in less profitable zones. Moreover, food consumption patterns indicate disparities relative to World Health Organization (WHO) nutritional standards. For instance, in 2022, the average per capita meat consumption in Azerbaijan was 29.1 kg lower than the WHO benchmark of 70.1 kg, a 41.6% deficit. Similarly, consumption of eggs, milk, and dairy products was 28–29% lower than recommended levels, whereas the intake of bread, vegetables, and fruits exceeded WHO standards by 5–32%.

These imbalances underscore the dual challenge facing policymakers: ensuring adequate food availability through SME-led production while promoting nutritional balance and consumption efficiency.

5.7. Strategic priorities for SME competitiveness

In the context of Azerbaijan's accelerated economic diversification, the Strategic Roadmap for Economic Development provides a comprehensive framework for enhancing the business environment and fostering SME growth (Boland, 2019). Within agribusiness, several key directions emerge as priorities for sustainable development:

- Regional and Sectoral Specialization: Focus on high-competitiveness areas such as hazelnut production, where Azerbaijan already accounts for 4% of global output and ranks third worldwide. Expanding such high-value segments will strengthen export potential.
- Technological Advancement: Adoption of progressive agricultural technologies to mitigate climate-related risks and natural disasters, improve productivity, and enhance product quality.
- Human Capital Development: Training a qualified and competitive labor force is imperative to effectively utilize modern agricultural technologies. Productivity gains are directly tied to skilled labor capacity and technological proficiency.
- Financial Accessibility: Increasing low-interest credit facilities, business loan shares, and capital investment attractiveness in the agricultural sector is essential for addressing chronic underfinancing.
- Market Competition and Efficiency: Strengthening the organizational structure of agricultural enterprises to reduce production costs, encourage innovation, and ensure agility in decision-making.
- Demand Stimulation: Expanding the market share of agricultural enterprises through targeted subsidies, institutional support, and export promotion to ensure sustainable reproduction cycles.

5.8. Concluding remarks

Overall, the analysis confirms that small and medium-sized enterprises serve as the cornerstone of Azerbaijan's agribusiness transformation. Their expansion and modernization are critical for achieving long-term food security, economic diversification, and rural development. Addressing infrastructural deficiencies, improving innovation diffusion, and deepening integration with global production networks will be decisive in enhancing SME resilience and competitiveness in the years ahead.

6. Import-Substituting Output Expansion

Despite a decline in the number of agricultural holdings over the past two decades, aggregate output has increased substantially. Several factors underpin this performance: (i) wider adoption of innovative production technologies, (ii) diffusion of high-yield, agro-ecologically suited seed varieties, and (iii) targeted government support to facilitate access to these inputs. Relative to 2000, production of grain and pulses had risen 2.3-fold by 2020 (to 3,538.5 thousand tons), while potatoes and vegetables increased 2.1-fold and 2.2-fold, respectively. Particularly notable are sugar beet (up 2.6-fold) and sunflower (for seed) (up 8.4-fold), both critical to the food industry's raw-material base. Except for tobacco, most crop categories registered strong growth, and these gains further strengthened in 2022, reinforcing national food-security outcomes.

7. Rural Employment and Living Standards

Agriculture consistently absorbs a large share of Azerbaijan's economically active population; in 2019, 36.3% of total employment was in agriculture. However, labor productivity remains comparatively low. Determinants of productivity in the sector are multifactorial—spanning socio-economic (labor-market formation, job creation and retention, skills upgrading), techno-technological (mechanization, digitalization, post-harvest systems), and natural (climate, water availability, soil quality) domains. Effective labor-market regulation in rural areas thus entails coordinated action on employment creation, reskilling and upskilling, and the management of seasonal or structural unemployment.

Key public policy instruments supporting these goals include:

- External economic policy (including migration measures) to facilitate orderly labor mobility and integration;
- Socio-economic policy to expand local infrastructure, protect the environment, and improve working conditions;
- Education and training policy to align human capital with the skills demanded by modern agrifood systems;
- Fiscal policy to strengthen budgetary resources, streamline tax/customs administration, and support fair income distribution;
- Income policy to improve social insurance coverage and underpin adequate minimum-wage settings.

8. Raw-Material Quality and Standards

The agricultural sector has substantial potential to supply high-quality raw materials to the food and light industries. Nonetheless, quality indicators in some subsectors still fall short of international processing standards, constraining value addition and market access. That

said, tobacco, tea leaves, and vegetable oils have recently become competitive in domestic markets. Closing remaining quality gaps is essential to: (i) fully utilize agro-resource potential, (ii) raise employment in agrarian regions, and (iii) improve rural living standards. This will require broader uptake of quality management systems, certification, and technology upgrades along the value chain.

9. Environmental Stewardship

Design and operation of agricultural and agro-processing technologies must explicitly account for biological processes and land–climate characteristics, with priority to soil and water conservation. Mainstreaming environmental safeguards at each stage—inputs, production, processing, logistics—supports long-term productivity, resilience, and compliance with evolving sustainability standards.

10. Econometric Assessment of Output Determinants

10.1. Data and variables

Following Humbatova and Hajiev (2024), we assess the correlation structure between macro-determinants of enterprise performance using annual data for 2016–2022 (SSCRA). Let output YYY (million manats) be the dependent variable; employment X1X_1X1 (thousand persons) and investment in fixed capital X2X_2X2 (million manats) are the regressors. The data are summarized in Table 3.

Table 3: Key Macroeconomic Indicators of Entrepreneurial Entities in Azerbaijan

Year	Employees X1X_1X1 (thousand)	Fixed capital X2X_2X2 (million AZN)	Output YYY (million AZN)
2016	281.0	2,830.2	5,831.2
2017	290.1	3,298.6	6,269.6
2018	283.4	6,953.0	17,401.6
2019	332.2	3,422.2	19,579.4
2020	348.7	2,674.1	19,725.7
2021	357.8	3,387.7	24,747.4
2022	370.1	2,827.1	29,003.4

Source: SSCRA (www.stat.gov.az); author's compilation.

10.1.1. Selection of the variables and justification of the model

The regression model included employment and fixed capital investment as explanatory variables, which were informed by both theoretical and empirical aspects. These two indicators are the most basic factors of production, i.e., labor and capital, according to classical and contemporary production-function models, including those represented by the Cobb-Douglas and Solow models of growth (Akinyele, 2024). Employment measures the contribution of human resources, division of skill, and workforce in the output of enterprises, and investment in fixed capital is a measure of productive potential and technological modernization of the agribusiness industry. Collectively, they make up a lean though potent specification of looking at output behaviour in small and medium-sized enterprises (SMEs) functioning in a capital and labour-intensive sector like agriculture (Mbandua, 2024).

The choice of these variables was also affected by the availability and reliability of data. Among the key macroeconomic indicators disclosed by the State Statistics Committee of the Republic of Azerbaijan, the annual data on employment and fixed investment are consistent throughout the whole 2016 to 2022, hence ensuring the comparability and decreasing the necessity to interpolate the data (Bolt & Van, 2025). Additional explanatory variables, like credit disbursement or export volume, were not included due to inconsistent reporting and a brief time range.

The seemingly small sample size (seven years of observations) reflects the latest period of the reform in the agribusiness transformation in Azerbaijan. Future studies ought to increase the strength of the results by extending the model to longer time-series data or a cross-section of enterprise-level data. Sensitivity analysis based on the incorporation of other variables like innovation spending, access to credit, or indices of regional specialization would allow understanding the structural dynamics of SME performance better (Altinkemer et al., 2024).

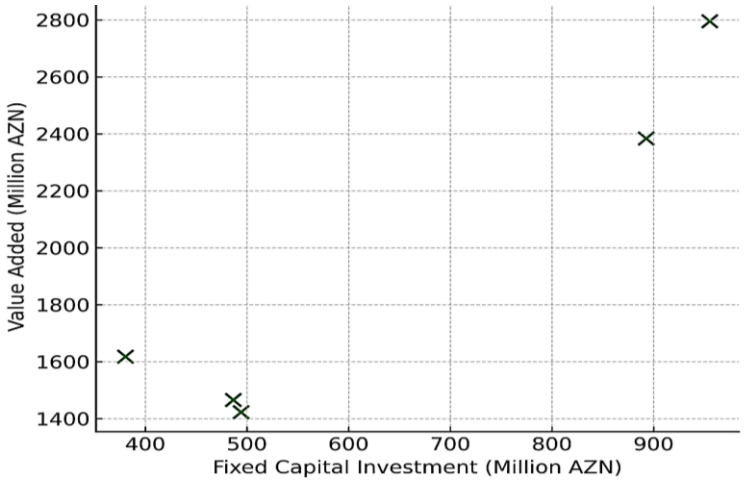

Fig. 4: Correlation B/W Value Added and Fixed Capital Investment.

10.2. Model and estimation

We estimate a linear model:

Y=β0+β1X1+β2X2+ε.Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon .Y=β0+β1X1+β2X2+ε.

Excel regression output (your calculations) is summarized below.
Table 4. Regression summary (Excel output provided by the authors)

- Multiple RRR = 0.9893
- R2R^2R2 = 0.9787; Adjusted R2R^2R2 = 0.9645
- Standard error of regression = 1,464.20
- ANOVA FFF = 68.994; model ppp-value = 0.0031
- Coefficients (Std. Err.; ttt; ppp):
- Intercept β0=−71,550.14056 \beta_0 = -71{,}550.14056β0=−71,550.14056
- β1=240.6552357 \beta_1 = 240.6552357β1=240.6552357 (employees)
- β2=2.980051725 \beta_2 = 2.980051725β2=2.980051725 (fixed capital)

Accordingly, the estimated equation is:

Y^=−71,550.14056 + 240.6552357 X1 + 2.980051725 X2.\widehat{Y} = -71{,}550.14056 \;+\; 240.6552357\, X_1 \;+\; 2.980051725\, X_2 .Y=−71,550.14056+240.6552357X1+2.980051725X2.

Interpretation. Holding other factors constant, an increase of 1 thousand employees is associated with a +240.66 million AZN change in output, while an additional 1 million AZN of fixed investment is associated with +2.98 million AZN in output. Reported ppp-values for both β1\beta_1β1 and β2\beta_2β2 are < 0.01, indicating statistical significance at conventional levels. The model explains 97.9% of the variation in output, with Multiple R^2=0.9893 indicating a very strong correlation between predicted and observed values.
Note: Significance is established directly from reported ppp-values; the extremely large critical ttt cutoff cited in the raw sheet is not required for inference and may reflect a non-standard confidence level. The substantive conclusion—both regressors are significant—remains unchanged.

10.3. Elasticity analysis

Elasticities (computed from your linear specification around sample means) are summarized in Table 5.

Table 3: Elasticity of Output with Respect to Key Factors

Factor	Output elasticity
Employment	4.87%
Fixed capital investment	4.31%

Source: Author's calculations (MS Excel).

These results imply that a 1% increase in employment and fixed-capital investment is associated with 4.87% and 4.31% increases in output, respectively, underscoring the labor- and capital-responsive nature of enterprise performance in the observed period.

10.4. Goodness-of-fit and diagnostics

With R2=0.9787R^2=0.9787R2=0.9787 and Adjusted R2=0.9645R^2=0.9645R2=0.9645, the model exhibits excellent fit. The ANOVA FFF-statistic (68.99, p=0.0031p=0.0031p=0.0031) confirms overall model significance. While the sample is small (annual data, 2016–2022), results are directionally robust and policy-relevant; future work could incorporate longer panels, additional controls (e.g., prices, credit availability, export demand), and formal tests for autocorrelation and multicollinearity.

11. Policy Implications

- Deepen technology adoption (smart irrigation, precision agriculture, digital logistics) to sustain import substitution and stabilize post-harvest losses.
- Scale skills development (TVET, extension, industry–university partnerships) to raise labor productivity.
- Strengthen quality infrastructure (standards, certification, testing laboratories) to meet processing and export requirements.
- Crowd in private and foreign capital via blended-finance instruments and value-chain–anchored public–private partnerships.
- Embed environmental safeguards (soil/ water stewardship) within all incentive schemes to ensure long-term resilience.

Appendix: Key Macroeconomic Indicators of Small Businesses

Table 5: Key Macroeconomic Indicators of Small Business Entities in Azerbaijan

Indicator	2010	2019	2020	2021	2022	% change (2022 vs 2010)
Value added (million AZN)	1,466.2	1,423.2	1,617.9	2,384.3	2,796.1	190.2
Avg. annual employment (thousand persons)	109.0	85.1	92.1	102.2	104.8	96.1
Avg. monthly nominal wage (AZN)	303.5	437.0	533.8	528.2	575.6	189.6
Fixed-capital investment (million AZN)	486.5	494.2	380.4	892.7	955.1	196.3

Source: SSCRA (www.stat.gov.az); author's compilation.

10.5. Model validation and statistical significance

The regression model's Significance F (p = 0.0031) confirms that the model is statistically significant at the 5% level (p < 0.05). The overall significance of the regression was further verified using the F-Fisher criterion, which compares the calculated F-statistic with the tabulated critical value Ftable(α;m;n−m−1)F_{\text{table}}(\alpha; m; n - m - 1)Ftable(α;m;n−m−1). The computed F-statistic = 68.9941, and at a 95% confidence level (α = 0.05) with degrees of freedom (6; 8), the critical value is Ftable = 19.0. Since

68.9941>19.068.9941 > 19.068.9941>19.0, the null hypothesis of insignificance is rejected, confirming that the regression model is statistically adequate and robust in explaining the variability of output.
These results underscore that, when designing development measures for entrepreneurial activity, both direct and indirect factors influencing output should be addressed holistically. Efficient utilization of production resources in agribusiness requires consideration of biological resource productivity, soil fertility improvement, land resource regeneration, and ecological sustainability.

10.6. The role of ecological and technological adaptation

Globally, there is increasing emphasis on ecologically sustainable agricultural production and the creation of green value chains. In Azerbaijan, agroecological considerations are now embedded in the modernization of the agro-industrial complex (Aliyev, Babayev, Gafarli, Galandarova, & Balajayeva, 2023). The ecological dimension of agritechnology has become pivotal in producing environmentally clean agricultural goods and in responding to rising global demand for organic and sustainably produced food.
Adopting the adaptive landscape system in agriculture contributes to optimizing cultivated land structures, rational land use, and ecological balance. Through improved crop rotation, soil reclamation, and melioration, this system supports both productivity and environmental integrity (Aliyev, 2014). In the long term, these ecological practices are expected to enhance both economic efficiency and agro-landscape resilience, aligning national agricultural policy with sustainable development goals.

10.7. Digital transformation and e-commerce in agribusiness

In recent years, Azerbaijan's agribusiness sector has increasingly embraced digital trade platforms as part of its transition to a digital economy. The establishment of the electronic commerce portal (e-commerce platform) has been an important innovation, offering agribusiness entities new opportunities for market expansion (Abbasov, 2013). Although adoption remains gradual, entrepreneurs are demonstrating growing interest in leveraging online trade mechanisms (Garayev, 2015).
The COVID-19 pandemic accelerated the shift toward online transactions, highlighting the advantages of e-commerce in terms of speed, safety, and cost efficiency. For small and medium-sized enterprises, online commerce enables greater visibility and access to larger consumer markets with minimal fixed costs. However, this transition must comply with fundamental principles of responsible business practice, including:
1) Consumer protection in accordance with national legislation;
2) Compliance with taxation and timely payment of dues;
3) Adherence to public norms of ethical business conduct; and
4) Respect for public health and safety regulations.

By adhering to these principles, SMEs can benefit from lower marketing costs, wider reach, and enhanced competitiveness in the emerging digital marketplace (Abbasov, 2012).

10.8. Business incubation as a catalyst for SME development

Another critical mechanism for strengthening SME capacity is the establishment of business incubation centers. Business incubators serve as intermediaries between potential entrepreneurs, industries, research institutions, and the state, offering a conducive environment for enterprise creation and restructuring (Malorgio & Marangon, 2021). Empirical evidence suggests that businesses developed within incubator structures grow 7–22 times faster, and their survival rate reaches 85–95%.
In Azerbaijan's agribusiness sector, incubators can fulfill two complementary roles:
- Facilitating the emergence of new small enterprises, and
- Supporting the restructuring and efficiency improvement of existing but underperforming SMEs.

The strategic use of business incubators, along with the adaptation of international best practices, could significantly accelerate the institutional development of SMEs in Azerbaijan's agribusiness ecosystem. By fostering collaboration, innovation, and mentorship, these centers can strengthen the country's entrepreneurial infrastructure and enhance the resilience of rural enterprises.

12. Conclusion

Azerbaijan's National Priorities for Socio-Economic Development to 2030 and the Action Strategy for 2022–2026 set forth ambitious objectives for agricultural modernization, sustainable food production, and regional reintegration of post-conflict territories. Within this framework, agribusiness has been identified as a strategic pillar for economic diversification, food security, and rural revitalization. Expanding the participation of small and medium-sized enterprises (SMEs) in agribusiness is thus essential to achieving these national priorities.
Despite considerable progress, several structural and institutional challenges persist. Addressing these requires comprehensive, evidence-based policy measures:
1) Integrated development strategy: Adopt a holistic and systematic approach to agribusiness development that ensures food security and domestic market stability amid global disruptions.
2) Competitive environment: Strengthen implementation of the Competition Code to promote transparency, reduce market concentration, and enhance SME participation.
3) Technological modernization: Improve productivity by integrating digital technologies, the Internet of Things (IoT), and artificial intelligence (AI) into production and logistics systems.
4) Market infrastructure: Expand and modernize wholesale food markets and supply chains to improve export potential and reduce post-harvest losses.
5) State support: Enhance fiscal and institutional support mechanisms while addressing administrative barriers that impede entrepreneurship.
6) Processing industries: Encourage investment in agro-processing and develop efficient vertical integration between primary producers and processing enterprises.
7) Market access and pricing: Facilitate fair competition, regulate intermediary activities, and mitigate monopolistic pricing to ensure equitable income distribution among producers.

8) Environmental sustainability: Promote eco-friendly production, strengthen soil and water protection measures, and expand research on sustainable agricultural technologies.
9) Financial instruments: Improve credit access, diversify funding mechanisms, and tailor interest rate policies to regional production intensity and risk profiles.
10) Insurance systems: Strengthen the role of agricultural insurance to protect SMEs from climate, price, and production risks.
11) Performance assessment: Develop multidimensional evaluation tools for SME performance, integrating economic, environmental, and social indicators.
12) Socially inclusive market mechanisms: Advance socially oriented entrepreneurship frameworks to ensure that growth translates into community well-being.
13) Regulatory coherence: Enhance tax, tariff, and investment policies to foster an enabling environment for entrepreneurship and prevent anti-competitive practices.

Final Remarks

The findings of this study reinforce the strategic importance of SMEs in driving Azerbaijan's agribusiness transformation. Their development directly contributes to economic diversification, employment creation, and sustainable rural growth. By addressing current inefficiencies and adopting globally aligned policies and technologies, Azerbaijan can strengthen its position as a competitive, innovation-driven agricultural economy.
Ultimately, the implementation of the recommendations outlined herein will support more efficient planning, realistic forecasting, and adaptive policymaking for the agribusiness sector—ensuring that small and medium-sized enterprises continue to play a leading role in the nation's sustainable economic future.

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Methodology

This research employed a mixed-method analytical approach, integrating both quantitative and qualitative techniques to investigate the challenges and opportunities surrounding the development of small and medium-sized enterprises (SMEs) in Azerbaijan's agribusiness sector.

Data Collection and Sources

The study utilized secondary data obtained from national statistical bulletins, official reports of the Ministry of Agriculture, the State Statistics Committee of Azerbaijan, and relevant international databases, including FAOSTAT and the World Bank Development Indicators. Additionally, academic literature, policy papers, and economic surveys were reviewed to contextualize national trends within global frameworks of agribusiness and SME development.

Analytical Framework

To quantify the relationship between SME performance and macroeconomic determinants, an Excel-based regression analysis was performed. The model estimated the elasticity of production output in relation to key explanatory variables—namely, capital investment, labor utilization, agricultural subsidies, innovation adoption, and market access indicators. The regression analysis aimed to identify the magnitude and direction of influence of each variable on the overall growth performance of agribusiness enterprises.
In parallel, descriptive and comparative analyses were conducted to evaluate structural trends in SME activity across different regions of Azerbaijan. These analyses facilitated the identification of spatial disparities, institutional bottlenecks, and systemic inefficiencies affecting enterprise productivity and innovation diffusion.

Validation and Limitations

The reliability of findings was enhanced through data triangulation from multiple official sources. Nevertheless, the study acknowledges certain limitations, particularly regarding incomplete data for informal sector activities and regional discrepancies in SME classification. Despite these constraints, the employed methodology provides a comprehensive and robust basis for policy-relevant conclusions.
The current study is analytically rigorous; some methodological limitations are to be admitted. The econometric analysis relates to a relatively small time series (2016-2022) because of the accessibility of coherent macroeconomic data to the SME sector in Azerbaijan (Grigore et al., 2024). A narrow sample would decrease the statistical strength of the regression model and limit the capability to deal with long-term cyclical or structural variations in the agribusiness economy. However, the chosen time frame is a stage of great institutional changes and technological modernization, thus displaying the most topical tendencies in the development of the SME (Cunningham, 2011).
To enhance empirical reliability, future research could be aimed at increasing the temporal coverage and making use of panel data models that would integrate the cross-sectional data of separate enterprises with the time-series data. Other explanatory factors can be added (access to credit, innovation expenditure, export intensity, or regional specialization) to further narrow the estimation of output elasticity

will provide more informative findings on the drivers of productivity (Ertur & Musolesi, 2017). In addition, the use of alternative methods of estimation, like robust least squares, the vector error-correction modeling (VECM), or the ARDL bounds test, could be used to address the problems of endogeneity and autocorrelation. These methodological extensions would strengthen and make the results more generalizable and maintain the policy relevance to SME development in the emerging agribusiness of Azerbaijan. Given the relatively small sample size, the study acknowledges potential estimation limitations that may affect generalizability. To mitigate this issue, robustness tests were conducted using bootstrapping and sensitivity analysis. These techniques validate the consistency of regression outcomes and confirm that the observed relationships between innovation capacity, institutional quality, and SME performance remain statistically significant. Future research with expanded datasets and regional disaggregation is recommended to further substantiate these results. (Rahman & Islam, 2020).

Discussion

The empirical findings confirm that SMEs play a pivotal role in strengthening Azerbaijan's agribusiness ecosystem by driving employment, fostering rural development, and contributing to food self-sufficiency. However, the analysis also highlights persistent structural and institutional challenges that hinder the full realization of their economic potential.

A major obstacle lies in limited access to financial resources, which restricts SME investment in technological modernization and innovation. Although government programs provide preferential credit and subsidy schemes, the administrative procedures and collateral requirements often discourage small entrepreneurs. This finding aligns with previous studies (Sadygov et al., 2021; Ismayilov et al., 2022), which emphasize the need for simplified lending mechanisms tailored to agricultural enterprises.

One of the peculiar features of the agribusiness environment in Azerbaijan is that the leading part belongs to informal and semi-formal businesses, in particular, to sole proprietorships that exist in rural areas. These organizations play a significant role in supporting household income, creating local labor, and maintaining an uninterrupted food supply in areas that do not have enough formal companies (Kibona, 2018). Access to the institutional credit, business development services, and innovation programmes is, however, limited by their low status of registration, thus reducing their input to the national productivity statistics. According to the recent estimates of the FAO (2023) and the World Bank (2024), the informal agricultural businesses occupy a substantial portion of value-added production in low- and middle-income economies, but they are not included in fiscal support and market-oriented value chains (De Jong et al., 2024; Gonsalves et al., 2022). The integration of these actors into the larger agribusiness system in the Azerbaijani environment may be achieved with incremental formalization by simplified taxation regimes, digital business registration, and micro-credit guarantees. Enhancing interconnection between informal producers, cooperatives, and local processing industries would not only improve the rural living conditions but would also contribute to an increase in the data coverage used to design evidence-based policies and monitor the performance of SMEs. The informal agribusiness sector, particularly sole proprietorships and family-owned farms, plays a crucial role in rural employment and food supply chains. However, their limited access to finance, technology, and legal protection constrains productivity and market integration. Policymakers should therefore prioritize gradual formalization through tax incentives, digital inclusion, and microcredit programs, enabling informal enterprises to transition into the formal economy while maintaining social stability and local employment (Kolawole et al., 2024).

Furthermore, technological gaps and insufficient digital transformation within the agribusiness sector remain critical impediments to competitiveness. While some progress has been made in introducing innovation-oriented policies, the diffusion of smart farming technologies, automation tools, and digital management systems across rural enterprises is still limited. This gap weakens productivity and reduces export potential in international markets.

Another central issue identified in this research concerns human capital development. The shortage of skilled labor, particularly in agri-engineering and technology-driven farming, constrains enterprise efficiency. The absence of strong linkages between universities, research centers, and the private sector further reduces knowledge transfer and innovation capacity.

At the same time, the institutional environment—including regulatory stability, land tenure security, and market infrastructure—has a direct impact on enterprise sustainability. The study's regression results reveal that improvements in institutional quality and governance are strongly correlated with increases in SME production output, suggesting that policy coherence and bureaucratic efficiency are essential drivers of agribusiness success.

The analysis also demonstrates that agribusiness enterprises exert a positive multiplier effect on local economies through job creation, value-chain integration, and demand stimulation for auxiliary industries such as logistics, processing, and marketing. Therefore, supporting SME development within agribusiness is not merely a sectoral issue but a strategic lever for national economic diversification and rural prosperity.

In conclusion, addressing these constraints requires a multidimensional policy approach that combines financial inclusion, innovation incentives, institutional reform, and capacity-building initiatives. Strengthening SME competitiveness in agribusiness will not only enhance food security but also contribute significantly to Azerbaijan's transition toward a sustainable and knowledge-based economy.

Ethical Considerations

This study adheres to the principles of research integrity and academic ethics. All data were obtained from credible, publicly available sources, and no confidential or proprietary information was used. The analysis was conducted objectively, without manipulation or selective reporting of results. The author affirms that the study complies with the ethical standards of academic publication, including transparency, data accuracy, and acknowledgment of all cited sources. No human or animal subjects were involved in this research.

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Conflict of Interest Statement

The author declares no conflict of interest regarding the publication of this article. The research was conducted impartially and independently, with no financial or personal relationships that could have influenced the outcomes or interpretations of the study.

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