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Development trends of viticulture and winemaking enterprises in Azerbaijan

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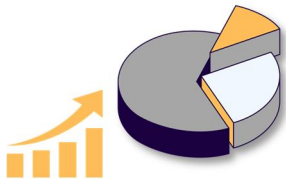
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Abstract. *The article presents the results of a study on the development of viticulture and production enterprises in Azerbaijan. Based on the analysis of key performance indicators of enterprises during 2019–2023, it is concluded that the sector makes a stable contribution to the overall volume of agricultural production. It is noted that despite the trend of decreasing vineyard areas, enterprises in the sector ensure an increase in grape yield, particularly among private and family farms, as well as an increase in grape processing volumes. The analysis of the relationship between key performance indicators of viticulture and production enterprises revealed a strong correlation between grape yield and wine production volumes. A direct moderate relationship was established between grape yield and the cost of cultivation. Despite some challenges, such as the reduction in vineyard areas, enterprises are adapting to the new business conditions by improving resource utilization efficiency and*



increasing yields. The rising costs of grape cultivation require finding ways to optimize expenses and implementing innovative methods in the industry to further enhance its productivity and competitiveness in the international market.

Keywords: viticulture and production sector, enterprise, correlation, factors.

Тенденції розвитку виноградарсько-виробничих підприємств Азербайджану

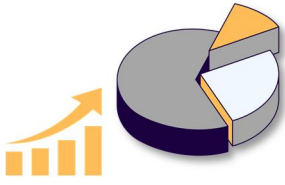
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***Анотація.** У статті наведено результати дослідження розвитку виноградарсько-виробничих підприємств Азербайджану. За результатами дослідження основних показників діяльності підприємств протягом 2019–2023 рр. зроблено висновок про стабільний внесок галузі в загальний обсяг сільськогосподарської продукції. Відзначено, що незважаючи на тенденцію до скорочення площ виноградників, підприємства галузі забезпечують зростання врожайності винограду, зокрема серед приватних та сімейних господарств, а також збільшення обсягів переробки винограду. Аналіз зв'язку між ключовими показниками діяльності виноградарсько-виробничих підприємств виявив тісну кореляцію між врожайністю винограду та обсягами виробництва вина. Між врожайністю винограду та собівартістю його вирощування встановлено*



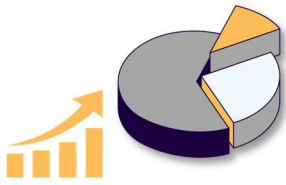
прямий помірний зв'язок. Незважаючи на деякі проблеми, такі як скорочення площ виноградників, підприємства адаптуються до нових умов ведення бізнесу, підвищуючи ефективність використання ресурсів і збільшуючи врожайність. Зростаючі витрати на вирощування винограду вимагають пошуку шляхів оптимізації витрат та впровадження інноваційних методів у галузі для подальшого підвищення її продуктивності та конкурентоспроможності на міжнародному ринку.

Ключові слова: *виноградарсько-виробнича галузь, підприємство, кореляція, чинники.*

Introduction. Viticulture in Azerbaijan is one of the oldest agricultural sectors, with a centuries-old history closely linked to the country's cultural heritage. Favorable climate conditions, fertile soils, and winemaking traditions have created unique opportunities for the development of this sector, which remains an essential part of the national economy and a significant contributor to exports. Modern Azerbaijani viticulture combines ancient grape-growing methods with innovative technologies, enabling the production of high-quality wines that receive recognition at international competitions.

The winemaking sector in Azerbaijan plays a vital role in the development of the national economy, supplying the domestic market with high-quality products and strengthening the country's export potential. In the context of globalization and increasing competition, enhancing the efficiency of viticulture enterprises through resource optimization and the implementation of modern management practices has become a pressing task. Given the strategic importance of the sector, effective planning and management of viticulture enterprises have become particularly relevant. This necessitates identifying factors that influence production volumes and ensuring the stable growth of the sector under current conditions.

Analysis of recent research and publications. The issues of development and effective management of viticulture and production enterprises have been studied by

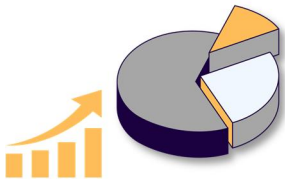


Alikberova M., Aslanova F., Enjindeniz S. [1], Salimov V., Madjnunlu U., Gasanov R. [2], Bashirov I. [3], Khalilova I., Eminova F. [4], and Gakhramanov B. [5]. Examples of management decision-making using methods of analysis and modeling the performance of viticulture enterprises are presented in the works of Namdari M., Mobtaker H.G., Rasouli M. [6], Obnyavko V.O. [7], Vdovenko N.M., Pereguda Yu.A., and Yatsun A.G. [8].

The theoretical foundations and practical aspects of developing viticulture enterprises were explored by Alikberova M., Aslanova F., and Enjindeniz S. [1]. The article [1] examines the sources of risks in grape production and provides recommendations for their mitigation. The authors analyze risks across key stages of grape production and marketing, highlighting those related to production technology, sales, financial, human resources, and natural risks [1, pp. 50–51]. The publication provides strategies to minimize risks in viticulture, emphasizing factors such as grape type (table or technical), region of cultivation, site selection, planting schemes, monitoring of grape ripening, agrotechnical measures, and insurance against climate change risks [1, pp. 52–53].

Salimov V., Madjnunlu U., and Gasanov R. in their publication [2] present research results showing that grape characteristics (size, weight, oil content, and juice yield from grape seeds) depend on a combination of factors, including grape variety and growing conditions. The authors note significant variation in key parameters such as sugar content, acidity, and berry size in grapes cultivated under irrigation versus rainfed conditions. They also highlight a strong correlation (coefficient of 0.94) between the total grape yield in Azerbaijan and productivity in the sector, indicating a near-direct relationship [2, p. 150].

Bashirov I. [3] addresses the formation of strong competitive positions in Azerbaijan's wine industry, emphasizing the need for enterprise owners and managers to revise business models. He advocates restructuring based on consumer value, leveraging not only material but also organizational resources and enterprise capabilities [3, p. 331].



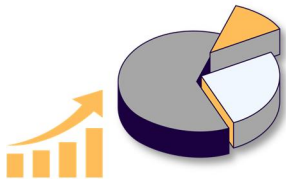
The article by Khalilova I. and Eminova F. [4] focuses on the implementation of green economy principles in Azerbaijan. The authors analyze the development of a green economy using examples of export-oriented goods in the light industry and food sectors, highlighting wine production as one of the key products. Although wine production lags behind non-alcoholic beverages in terms of volume [4, p. 428], it is part of a group of goods in demand on international markets [4, p. 425].

Gakhramanov B. [5] analyzed the dynamics of viticulture development in the Mountain Shirvan economic region. He emphasized that viticulture is the primary agricultural sector in this area of Azerbaijan. The study identified growth trends in vineyard areas, noted declines in yield and production, and concluded that reduced yields have diminished public interest in viticulture. The researcher also highlighted the lack of clear specialization in viticulture in the region, which negatively affects the supply of raw materials to winemaking enterprises [5, p. 61].

The methodology and tools used to study viticulture issues are also noteworthy. Namdari M., Mobtaker H.G., and Rasouli M. [6] explored the energy efficiency of viticulture using DEA analysis, a non-parametric method for assessing the relative efficiency of economic entities. Input factors included labor, fuel consumption, electricity, chemical fertilizers, irrigation water, and others [6, p. 487], while the output was grape production volume. The study found that only one-third of farmers effectively organized grape cultivation, achieving stable yields and high profitability, while the rest faced issues of over-expenditure.

The economic potential of winemaking enterprises was examined by Obnyavko V.O. [7], who analyzed the performance of winemaking enterprises in the Odesa region using a graph-analytical method. The analysis included elements such as production and sales, inventory, costs, economic efficiency, labor activity, and financing [7, p. 183]. The study concluded that there is an imbalance in the potential indicators and structural management issues in these enterprises [7, p. 190].

The modeling of management systems for winemaking enterprises, incorporating behavioral and circular economy principles, was examined by Vdovenko N.M., Pereguda



Yu.A., and Yatsun A.G. [8]. They used the AGMEMO partial equilibrium model to analyze the impact of agricultural policy on the winemaking sector, enabling the simulation of production, consumption, prices, and trade dynamics for wine products under internal and external market factors and policy instruments. The study highlights the necessity of integrating behavioral and circular economy principles to strengthen Ukrainian producers in the wine market [8, p. 33].

Given the above findings and the significance of winemaking in Azerbaijan's economy, further research is needed to enhance the effective management of viticulture enterprises. This includes using econometric methods to assess their development.

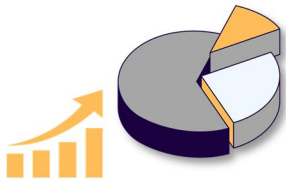
Identification of previously unresolved parts of the overall problem. The development of viticulture in Azerbaijan faces several challenges, including the reduction of vineyard areas, inefficient cost management, market fluctuations, and the impact of climate change. At the same time, the strategic management of enterprises, particularly the implementation of digital technologies and innovations, remains insufficiently explored.

The authors' contribution focuses on: (1) developing vineyard preservation strategies, (2) optimizing cost efficiency, (3) analyzing market factors, (4) adapting to climate change, and (5) integrating digital technologies. This will facilitate the formulation of effective policies and enhance the competitiveness of the sector.

Formulation of the Article's Objectives. The purpose of this article is to investigate the key performance indicators of viticulture and production enterprises in Azerbaijan and to determine the relationships between them.

Materials and Methods of Research. The study was conducted using economic analysis methods to identify development trends in viticulture and production enterprises; econometrics, particularly correlation analysis, to determine the relationships between the performance indicators of these enterprises; and the method of scientific abstraction to formulate generalizations and conclusions.

The assessment of development trends for Azerbaijan's viticulture and production enterprises was carried out in two stages. In the first stage, changes in the main performance



indicators of viticulture and production enterprises were analyzed, specifically grape yield, grape production cost, and wine production volume. In the second stage, the existence of relationships between these indicators was tested. Calculations were performed using data from the State Statistical Committee of the Republic of Azerbaijan [9, 10].

Research Results. Viticulture is one of the priority areas of activity for agricultural enterprises in Azerbaijan. The share of grape production in the gross volume of agricultural products has remained stable, accounting for 1.4–1.5% over the years (Table 1).

Table 1 – Structure of Production by All Categories of Farms in Azerbaijan for 2019–2023, %

Indicator	2019	2020	2021	2022	2023
All categories of farms	100,0	100,0	100,0	100,0	100,0
Crop products, including	47,9	47,8	49,2	50,4	48,6
grape production	1,4	1,4	1,5	1,4	1,5
Animal products	52,1	52,2	50,8	49,6	51,4

Source: [9, p. 66].

During 2019–2023, the share of enterprises primarily engaged in viticulture among all agricultural enterprises increased. In 2019, the share of such enterprises in the total number of agricultural enterprises in Azerbaijan was 1.2%, while in 2023; it was 1.5% [9, p. 67].

Between 2018–2023, a decrease in vineyard areas was observed, including among those of productive age. In 2023, the total area of vineyards amounted to 15.0 thousand hectares, which is 0.7 thousand hectares less than in 2022. The area of vineyards of productive age decreased by 0.6 thousand hectares during this period, from 14.6 thousand hectares in 2022 to 14.2 thousand hectares in 2023 (Figure 1).

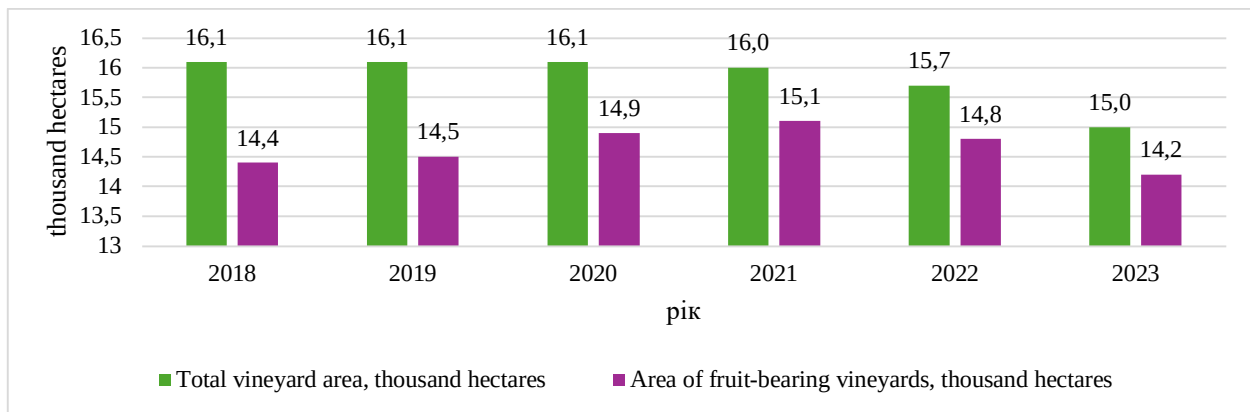
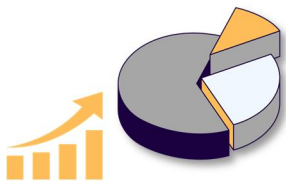


Fig. 1. Area of vineyards in Azerbaijan, thousand hectares (Source: [9, p. 40])

The main indicators of viticulture development are yield and production cost, as they directly impact the economic efficiency of enterprises and the competitiveness of products. Yield determines the volume of harvested crops per unit of area, which is a key factor in increasing production and enterprise income. Higher yield allows for reducing costs per unit of production and increasing profitability. Production cost reflects the expenses related to growing, caring for, harvesting, and processing grapes. Lowering production costs contributes to increased profitability and ensures stable enterprise development even amidst market price fluctuations.

An analysis of grape yields across farms in Azerbaijan during 2015–2023 shows that this indicator varies and changes depending on the group of enterprises studied. Against the backdrop of increased grape yields across all categories of farms, the highest yield growth was recorded among private and family farms. While the grape yield across all farm categories increased 1.3 times (from 86.6 quintals per hectare in 2015 to 113.3 quintals per hectare in 2023), for private and family farms, this indicator increased 1.5 times (from 98.3 quintals per hectare in 2015 to 144.0 quintals per hectare in 2023). For other agricultural enterprises, a decrease in grape yield by 1.2 times was observed (from 54.0 quintals per hectare in 2015 to 45.4 quintals per hectare in 2023) (Figure 2).

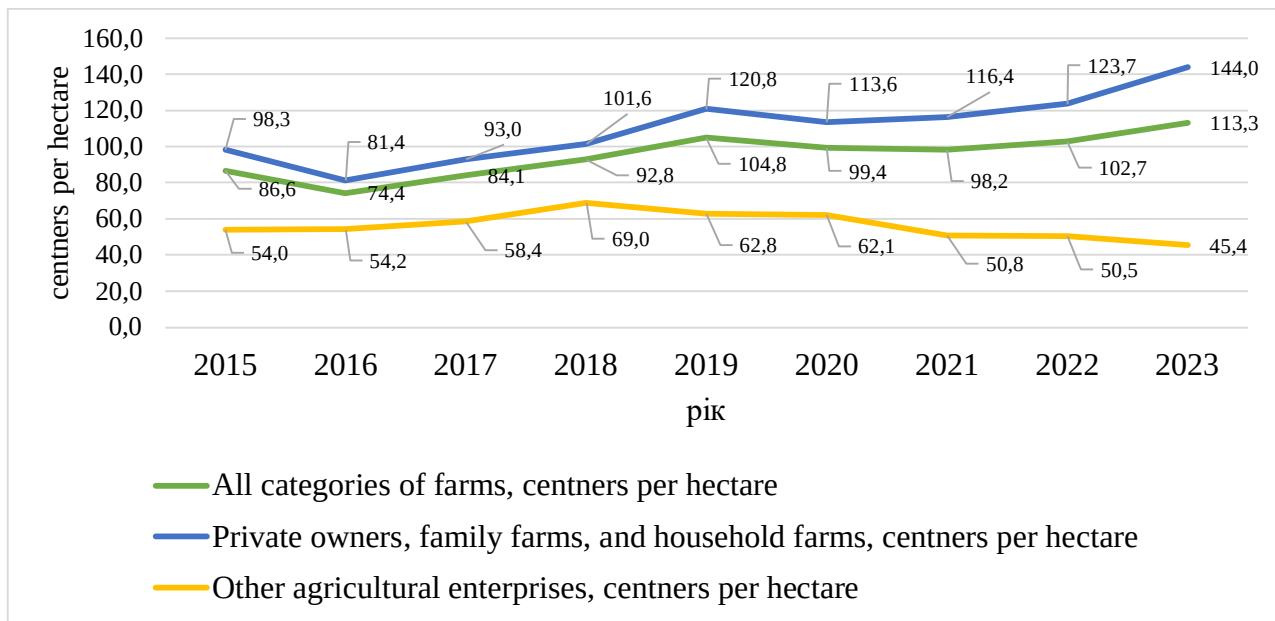
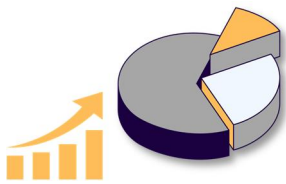


Fig. 2. Grape yield by farms in Azerbaijan from 2015 to 2023, quintals per hectare (Source: [9, p. 92])

The analysis of costs in the viticulture segment for 2019–2023 revealed an increase in production cost for this product by 1.3 times: from 41.07 manat in 2019 to 54.57 manat per 100 kg of grapes in 2023 (Figure 3).

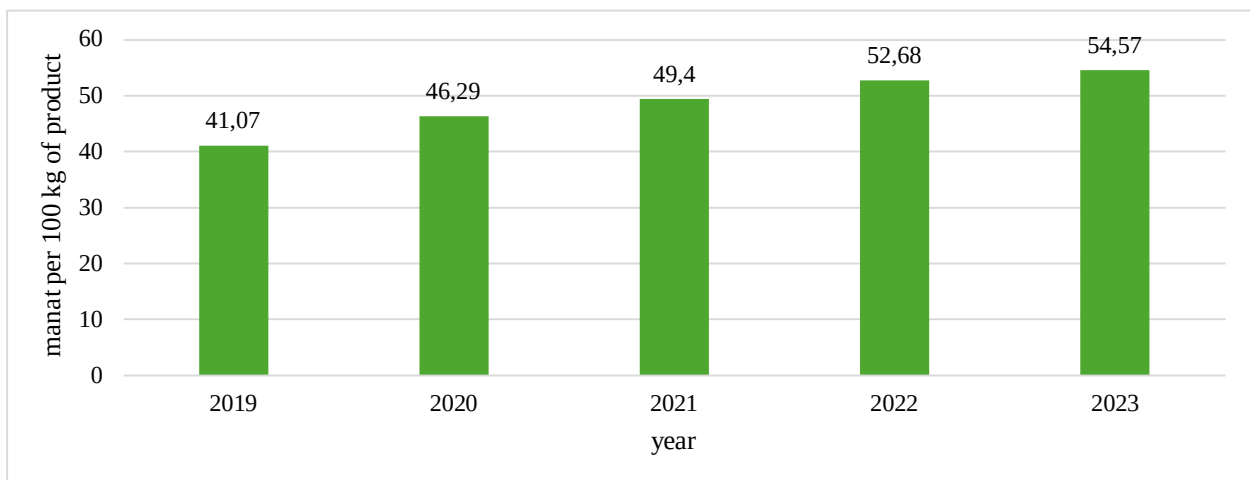
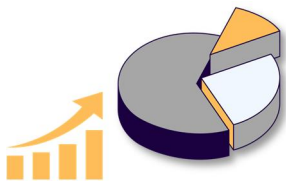


Fig. 3. Production cost of grapes in farms of Azerbaijan from 2019 to 2023, manat per 100 kg of product (Source: [9, p. 110])

An important characteristic for assessing trends in the development of the viticulture and winemaking industry is the volume of grape processing and product



production. The growth in the volume of grape processing indicates the development of the winemaking industry, the expansion of product range, and an increase in its competitiveness in both domestic and international markets. Winemaking enterprises that effectively utilize local raw materials contribute to increasing investment in production modernization, the development of technological innovations, and the creation of new jobs. Additionally, grape processing helps reduce seasonal income fluctuations for viticulture enterprises, as wine products have a longer shelf life and gradually increase in value over time. This creates additional opportunities for exports and the growth of the country's economic potential. Thus, a comprehensive analysis of grape processing volumes and wine production is a crucial tool for assessing the industry's dynamics, planning production capacities, and determining the prospects for the development of Azerbaijan's winemaking industry.

The analysis of wine production in Azerbaijan [10] shows an increase in this indicator over the years. From 2015 to 2023, wine production grew by 1.2 times: from 1,034.9 thousand decaliters in 2015 to 1,282 thousand decaliters in 2023 (Figure 4).

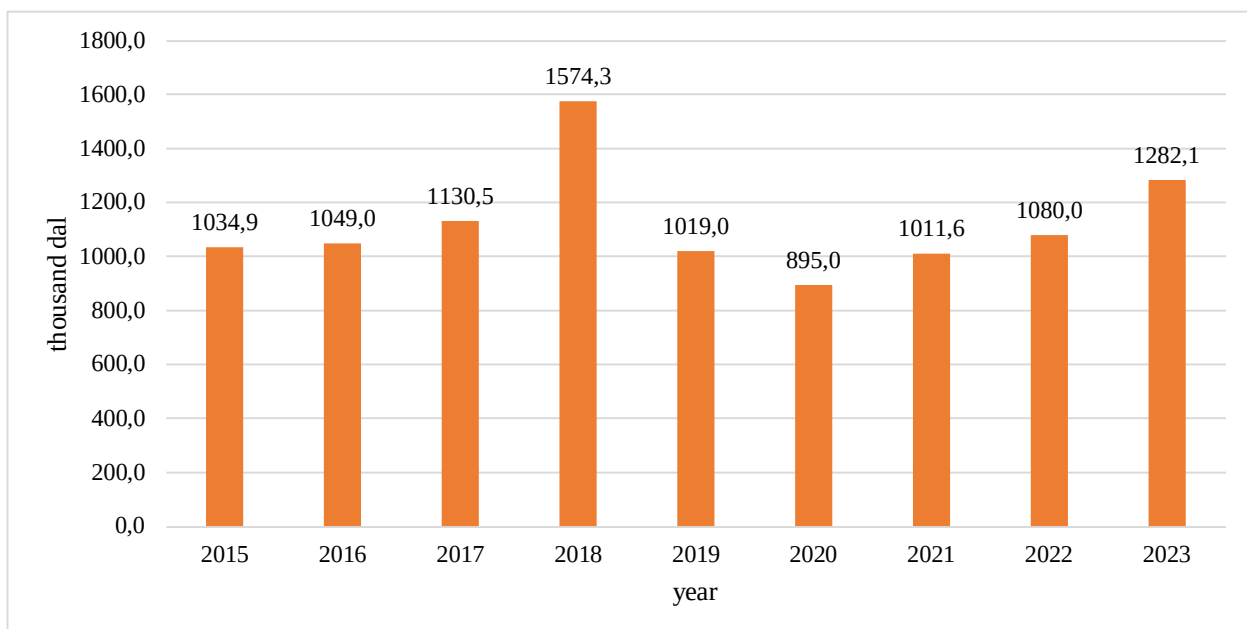
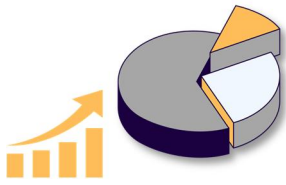


Fig. 4. Wine production in Azerbaijan from 2015 to 2023, thousand dal (Source: [10])



Despite the increase in wine production from 2019 to 2023, the wine production volume in 2023 did not reach the level of 2018, when 1,574.3 thousand deciliters were produced.

Adhering to the principle of organizing effective production in the viticulture and winemaking sector justifies the need to examine the relationships between the main performance indicators of enterprises in this field. Identifying dependencies between grape yield, production cost, and the volume of finished product production serves as a tool for improving production efficiency and ensuring the competitive advantage of winemaking enterprises. Understanding the connections between these indicators helps enterprises forecast production volumes and avoid a shortage or surplus of wine products.

Based on the publication [2, p. 150], the correlation analysis method was used to identify dependencies between the main indicators. Two types of dependencies were studied: between grape yield and wine production volume, and between the cost of growing grapes and grape yield. In the first relationship, the result variable is the volume of product production, and the factor variable is grape yield; in the second relationship, the result variable is grape yield, and the factor variable is the cost of growing grapes. The purpose of this stage of the study was to determine the nature and degree of the influence of factor variables on the result variables.

The foundation for studying these dependencies was based on the positions presented in the publications of Badalov K.M. [11], Gavryliuk V.M., and Marchuk N.A. [12], which note that "cost is closely related to product yield" [11, p. 91], and also state that yield and cost are factors influencing the performance of agricultural enterprises (in [12], this refers to profit). Data on wine production, grape yield, and cost of production for all groups of agricultural enterprises in Azerbaijan for the period 2019-2023 were used for calculations (Figures 2-4). The results of the correlation relationships between the factors under study are presented in Table 2.

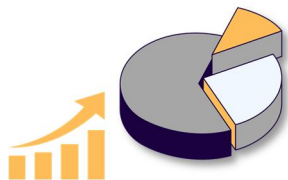


Table 2 – Correlation Coefficients Between Wine Production, Grape Yield, and Production Costs

Indicator	Wine Production (thousand dal)	Yield (centners per 1 hectare)	Cost (manat per 100 kg of grapes)
Wine Production (thousand dal)	1,00	–	–
Yield (centners per 1 hectare)	0,89	1,00	–
Cost (manat per 100 kg of grapes)	0,68	0,39	1,00

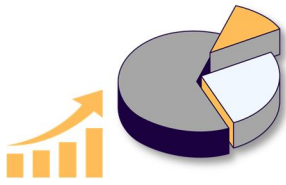
Source: Calculated independently.

The obtained correlation coefficients allowed for the following conclusions. There is a strong direct relationship between grape yield and wine production volume in Azerbaijan. The correlation coefficient is 0.89. The simplicity of this conclusion reflects a superficial understanding of the research results, as higher yield does not always guarantee greater production volume. It should be noted that in cases of excessive yield, the concentration of sugars and acids in grapes may be lower, negatively affecting the taste characteristics of the wine. Therefore, grape yield is regulated to ensure the quality of the raw material.

Regarding the relationship between grape yield and growing costs, the calculated correlation coefficient (+0.39) indicates a direct, yet weak, relationship between these two indicators. This suggests that costs affect yield, but they are not a decisive factor.

Conclusions. Viticulture in Azerbaijan is one of the key sectors of agriculture. The development of this sector is influenced by favorable natural and climatic conditions, fertile soils, and the preservation of winemaking traditions.

The analysis of the activity of viticulture and winemaking enterprises showed the sector's stable contribution to the gross agricultural output. The share of viticulture in the gross agricultural output has remained consistent. Although there has been a trend of decreasing vineyard areas in recent years, the growth in yield, particularly among

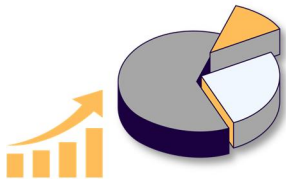


private and family farms, indicates efficient resource use and adaptation of Azerbaijani viticulture enterprises to new business conditions. A positive factor is the increase in wine production, signaling growing demand, the development of the winemaking industry, and enhanced competitiveness of enterprises in the market.

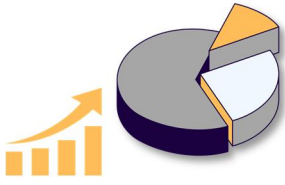
As a result of the analysis of the dependencies between key performance indicators of viticulture and winemaking enterprises, a strong direct correlation was established between wine production and grape yield. It was determined that growing costs have a positive effect, but do not always guarantee a significant increase in yield. This suggests the need for cost optimization and the search for additional ways to enhance the productivity of viticulture and winemaking enterprises.

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