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ECONOMETRIC ANALYSIS AND ASSESSMENT OF FACTORS AFFECTING THE EFFICIENCY OF AGRICULTURAL PRODUCTION

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Abstract

Taking into account that agricultural production interacts with various biological and natural processes, it is considered a fairly complex type of economic activity. The study of factors affecting the economic efficiency of agricultural production plays an important role in terms of efficient organization of production. The article presents the results of the analysis of the influence of the main factors on the gross output of the agricultural sector. The results obtained can be useful for both agricultural enterprises and private farmers, as well as government agencies for the optimal assessment of the state of agricultural policy and the development of the necessary conditions for the sustainable development of this industry. The main purpose of the article is to determine the level of influence of the most important factors on agricultural products, as well as forecasting these indicators for the prospective period.
In the study of this issue in the article, methods of econometric analysis and modeling, economic and statistical analyzes, and the method of comparative analysis of indicators were used. For this, the literature was studied, including articles, scientific journals, textbooks. The empirical statistical data were taken from the State Statistics Committee of the Republic of Azerbaijan. The results of research by some scientists were also considered, as well as their methodologies were used in econometric analysis. At the end of the study, using the software, predictive indicators of the degree of influence of factors on agricultural products were determined.

Key words**:** *agriculture, efficiency of production, correlation, econometric modeling, factors of production*

INTRODUCTION

Effective management of agricultural production depends on several factors. Based on the analysis of the activities of agricultural enterprises operating in the Republic of Azerbaijan, 2 groups of factors were identified that significantly affect the various processes of the value chain of agribusiness. These include production-technological factors that determine the characteristics of the production of agricultural products and market factors that ensure the sale and availability of products. The first group of factors includes the natural and climatic characteristics of the regions, energy resources, the existing financial and credit policy in the country, the level of scientific and technological development of the country, etc. factors that ensure the implementation of agricultural production. The second group of factors includes the factors that ensure the sale of products, such as the mechanism of agro-market activity. According to most economists, the factors affecting agricultural production are classified as follows: technical-technological, organizational, economic, social, and natural factors.

In addition, scientists have identified a subgroup of internal and external factors. Internal factors include factors that can be managed by agricultural enterprises, and external factors include factors that are outside the control and management of enterprises.

The results of the research show that these factors affect agricultural production to varying degrees, depending on the characteristics of the sector and the region, which creates several problems in determining which factors have the greatest impact on improving the efficiency of agricultural production. Scientists have identified a subgroup of internal and external factors.

Internal factors include factors that can be managed by agricultural enterprises, and external factors include factors that are outside the control and management of enterprises.

To ensure global competitiveness and food security at the national level, the analysis of the scientific views of various economists on the sustainable development of the agricultural sector plays an important role. Thus, according to the Azerbaijani economist E.A. Guliyev, it can be considered more effective to ensure the development of the agricultural sector through the joint application of extensive and mainly intensive forms of development. He attributed the expansion of arable and pasture areas, which directly affect the volume of agricultural production, based on extensive development factors. He noted that the intensive factors include the improvement of fixed assets, improving the quality of arable land, the application of scientific, technical, and technological innovations in production, improving investment attractiveness, and improving human capital. In addition, according to E.A. Guliyev's analysis, there are several fundamental conditions for ensuring large-scale reproduction in agriculture. These include reducing inflation, reducing price disparities, improving the material and technical base, and improving the financial and credit mechanism [11].

According to Baytasov R. and Zaharova V.S., several factors have significantly affected the efficiency of agricultural production, technical and technological restructuring of enterprises, state programs and laws to facilitate access to technical equipment, natural and climatic conditions of the regions, and labor potential [1].

According to Gurnovich's research in this area [4], sustainable agricultural production is a key factor in ensuring the country's food security. Taking into account the existing problems of the agrarian sector at several specific macro levels, sustainable development is considered one of the tasks facing the state. Gurnovich's research has identified a significant impact of several factors on the expansion of agricultural production. These include market factors (supply by suppliers, demand by traders, competition), scientific and technological progress (creation of new plant varieties resistant to drought or cold, creation of more productive hybrids, creation of innovative techniques and technologies, etc.), and mainly state support and regulation.

Gurnovich noted the special role of the state in achieving macro-stability in the agricultural sector. The formation of effective state investment and financial-credit mechanisms is of particular importance to increase the investment attractiveness of the agricultural sector, ensure economic and financial sustainability, expand the application of technical and technological progress in production and increase production in general [4].

Shamin's research emphasized that material and intangible resources affect the production performance of agricultural enterprises. Land and capital can be mentioned as material resources, and labor as intangible resources. In modern times, the main tasks of the country's agricultural development policy include the intensification of agricultural production [14].

Nechayev sustains that forecasting and planning are the basis of the activities of agricultural entities. Thus, in his opinion, forecasting is a scientific justification of the possible situation of agricultural producers in the long run and the optimization of economic activity, and improvement of activities in priority areas and forms the basis for planning the production activities of agricultural entities [9].

Kundius also affirmed that forecasting determines the optimization of agricultural production for the future, and the possibility of effective use of resource potential [7].

Kolmykov sustains that forecasting includes the implementation of important measures to achieve the goals of agricultural entities and the definition of development directions. Enterprise managers have the tasks to determine the direction of investment, diversify production, apply innovative technologies, identify the need to renew fixed

assets and improve management and forecasting [6].

To ensure the efficiency of the production activities of agricultural enterprises and individual entrepreneurs by the conditions of a market economy, the study of market relations at the micro and macro levels comes to the fore. At the micro-level, the operational strategies of the agricultural entity, production technologies, features of resources, and business process management are included. At the macro level, there are improvements in the legal framework governing agricultural production, effective financial and credit policies, increasing investment attractiveness, state programs for human capital development, state projects to stimulate exports, and state programs to improve the material and technical base, etc.

Given the importance of agriculture to the country's economy, ensuring its sustainability is a priority for the government. From this point of view, it is important to identify the factors of high importance in ensuring the efficiency of agricultural production, to make more rational decisions on their use. It is necessary to determine the level of impact of these factors, implement them systematically, prevent problems in this area, and identify priorities for the development of the agricultural sector, to ensure food security and international competitiveness of production [6].

Any economic activity is the basis of correct and effective management decisions. The economy is such a complex multi-level system that its effective management is possible only if it is possible to predict and comprehensively evaluate the results of decisions made. Therefore, it is necessary to develop multifaceted forecasts of indicators for the adoption of effective management decisions, as well as the formation of strategies and alternatives for the development of the country's economy, industries, regions, enterprises, and organizations.

Studies suggest that high-quality management of different levels of economic systems in modern conditions is possible only through the use of effective forecasting and planning mechanisms. This, in turn, allows predicting and evaluating the results of decisions made, as well as developing promising development programs.

In a market economy, given the uncertainty, intense competition, high level of risk and several other specific features of agricultural entities, it is important to identify and effectively manage the development of the sector in the long term.

In terms of the formation of an effective management system, the analysis of the factors affecting the sustainability of the field and, based on this, forecasting priorities for the future, as well as identifying key trends in rational use, characterizes the purpose and relevance of the article.

In modern times, the complexity of economic processes has laid the foundation for the formation and improvement of special methods of their analysis. From this point of view, economic-mathematical modeling and econometric analysis have become widely used. The econometric analysis allows us to express the results of research on the impact of one or another economic factor on another economic indicator. One of the main directions of econometric analysis is the development of forecasts for economic indicators. Forecasting of economic processes serves as a scientific basis for the formation of a strategy for any field or process. Economic forecasting allows determining the main criteria for the operation of productive forces, and their components in an interconnected and dependent situation, using special methods of calculation and modeling [11].

The analysis of economic indicators is based on the use of econometric modeling to substantiate analytical dependencies. The econometric research methods are used to check, evaluate and substantiate quantitative regularities based on the analysis of statistical data. The result of such research is the assessment of economic models and their elements, the examination of the characteristics of economic indicators, and their forms of communication. The results of economic analysis are used to forecast and make sound economic decisions.

After conducting economic analysis and calculations, the developed model will

determine the characteristics of the economic process, and on this basis, will provide a basis for predicting the future behavior of the process in the event of changes in any elements. In the created model, all the relationships of the variables are clearly shown and expressed in terms of quantity, which in turn allows to make a more accurate and qualitative forecast [12].

As a result of econometric analysis, using the tools of mathematical statistics and probability theory, it is possible to determine the existence, level, dynamics, and impact of the relationship between different economic indicators based on real statistical data. The econometric analysis identifies and analyzes quantitative patterns in socio-economic events and processes. These regularities are manifested in the form of correlation and dependence of economic indicators, and such correlation and dependence must be confirmed by real statistics [12].

Econometric methods and models are an important part of a system that supports sound economic and management decision-making. These methods are used to perform various tasks and analyses, such as studying the state of the enterprise, assessing the effectiveness of investment and innovation activities, building a supply-demand balance model, and identifying factors influencing any process. It is characterized by an econometric model, a system of equations and variables, which allows finding the most optimal variant of its development, taking into account the activities and characteristics of any object under study. It is known that the more accurate and detailed the analysis of the nature and content of the process or object under study, the interrelationships of its elements, and their impact on the final result, the more accurate and effective economic decisions will be. Econometric methods allow us to answer 2 main questions: what can happen in the future (forecasting of economic situations) and how one factor, its change can affect any other indicator [15].

Sustainable development of the agrarian sector of the Republic of Azerbaijan determines the food security of the country and the economic development of the country's economy. Ensuring sustainable agricultural production requires regular analysis of the current situation, development trends, market structure, and various factors affecting production. As a result of these analyzes, the development of a demand-supply balance model at the next stage is of particular importance. Thus, the market balance will ensure the dynamic development of local production, as well as the formation of a balance between supply and demand through the principle of independent pricing [11].

In a market economy, in an environment of uncertainty, it is important to estimate production for the foreseeable future, taking into account the specific characteristics of the agricultural sector, demand, and the factors that affect it. To some extent, this includes forecasting quantitative indicators based on past statistics.

Determining the factors that affect supply, including demand, has a special role in shaping the supply-demand balance model. However, each factor affects the volume of production to a different extent. From this point of view, the current state of the tax system in agriculture, the number of agricultural subsidies, favorable natural and climatic conditions, technical and technological progress, the number of producers, the price of substitute products, seasonality, etc. The implementation of modeling based on the identification of factors affecting the volume of production and regression-correlation analysis has high accuracy and stability. Thus, it has become necessary to determine the relationship between these factors and production volumes, and thus to assess the extent of their impact on market equilibrium. Regression and correlation analyzes are carried out to determine the share of various independent variables in the change in the volume of the object under study.

Thus, to optimize the production structure of agribusiness, it is important to study the dependence of production on several economic factors and conditions for the implementation of econometric analysis [6].

In modern conditions, ensuring the effective operation of the agricultural sector is possible through the effective use of organizational and economic methods and forms of activity in this sector. Along with the generally accepted methodology for assessing the use of agricultural resources, as well as the efficiency of production and economic activities, the application of specific methods of assessment is of particular importance. Thus, in this case, a special role is played by the analysis based on econometric methods related to the study of quantitative and qualitative relationships of economic objects and processes through mathematical-statistical methods and models. The basis of the econometric method is econometric modeling, which is a form of manifestation of socio-economic processes with scientific abstraction. An econometric model is the main tool of econometrics and is used to analyze and forecast economic processes. Correlation-regression analysis, which is used in the analysis of factors involved in the development of any enterprise or industry in general, to increase labor productivity and is considered one of the main methods of econometrics, provides a quantitative expression of the relationship between economic variables [2].

In this context, the purpose of the paper is to study the main factors influencing the development of agricultural production, econometric analysis of factors, determining the dependence and level of influence of these factors on gross agricultural output using correlation-regression analysis, as well as determining the forecast indicators of all factors and gross output using econometric modeling

MATERIALS AND METHODS

The econometric model is based on the construction of a multifactor regression equation, which takes into account the following aspects:

1. Selection of factors to be included in the model:

-Predicting the factors affecting the dependent variable;

-Comparative assessment, verification of collinearity between factors and subsequent selection of factors;

-Final selection of factors from the model development processand assessmentof the importance of the criteria;

2.Choosing the form of the relationship between the factors: the outcome factor and the influencing factors

3.Evaluation of the criteria (coefficient/indicator) of the equation

4.General evaluation of the model, analysis of residues

5.Evaluation of the results obtained as a result of practical application and forecasting of the developed model [5].

As in agribusiness, it is important to determine the extent to which the factors influencing supply can affect supply, usually correlation-regression analysis is used to solve this type of problem.

For example, to characterize the relationship between the volume of supply Y and the independent factors Y, it is possible to use the regression function X_1, X_2, ...X_z, which in turn determines how the expression Y will be for specific indicators of X [3]. If the number of factors influencing the result is large, the model of multivariate regression is used, and the purpose of this is to compile a model with multiple factors and determine their individual and cumulative effect on the result:

$$y = f(x_1, x_{2,\ldots\ldots} x_m) + \varepsilon \qquad \ldots\ldots\ldots\ldots\ldots (1)$$

where:

-X_1, X_2,....X_m are the supply factors, which have to meet the following requirements: to be expressed in quantitative terms, to be closely related to the outcome factor and not depend on each other.

-ε is the random error coefficient of the model for various factors.

The supply factors X_1, X_2,....X_m, as a rule, are selected in several stages. First of all, based on economic-theoretical research, the factors related to the studied economic process are identified. Then, using mathematical-statistical methods, the selected factors are re-analyzed, their impact on the studied process is checked, and the factors that have a little

impact are reduced. Proper selection of factors plays an important role in the development of a multivariate regression model. The result of the wrong choice is reflected in the model in the following form:

1)If the variable to be included is not included, the regression value is often distorted.

2)If the included variable should not be included, the regression value will be ineffective, even if it is not distorted.

Depending on the form of dependence, linear and nonlinear models of the multivariate regression model are used. Thus, according to the linear regression model, the coefficients a_j, j = 1, 2, ... m, in the case of invariance of other factors, with the change of the factor x_j, characterize the average change of the result, and are expressed in the following form:

$$Y= a_0+a_1x_1 +a_2x_2+.....+a_mx_m+\varepsilon \quad .. (2)$$

Here, the factors of influence must be determined by certain quantitative characteristics, in particular by the correlation coefficient, to determine the force of influence on the economic indicator. Thus, if the correlation coefficient is close to 1, then the influence of X_i factors on the variable Y is considered high, if the coefficient is equal to +1, then the relationship is directly proportional, otherwise, if equal to -1, the relationship is inverse is proportional if the correlation coefficient is 0, it means that the influence of X_i factors on the variable Y is insignificant.

In general, the development of an econometric model is a central problem of econometric research. Thus, it is the quality of this modeling that determines the validity and accuracy of the results of the analysis of development trends, the necessary forecasting capabilities for economic processes, and the necessary economic and management measures [13].

In addition, as a result of the influence of the independent factors X_j studied, the R^2-determination coefficient is used to calculate the variance fraction of the Y factor, so that it is possible to determine the variance fraction of the Y factor in the model. The closer the R^2 coefficient is to 1, the higher the quality of the model.

Official data of the State Statistics Committee of the Republic of Azerbaijan and MS Office Excel software were used to study the factors affecting production in the field of agribusiness in our country.

Initially, the selection of factors is made by taking into account the economic nature of the outcome factor. Several factors affect the volume of production in agribusiness, and they can be grouped as follows:

-Land resources and their structure: arable lands, arable lands, irrigated lands, fallow lands

-Water needs.

-Financial condition: credit availability, interest rates, the volume of investments, amount of subsidies. Taxes and financial investments (investments, subsidies, loans) - if the tax rate in the country is high, producers earn less and reduce supplies. If the government subsidizes producers, they will increase the supply of products.

-The current state of labor resources.

-Natural-climatic conditions: floods, landslides, air temperature, water, sun

-Level of provision of fixed assets

-Political factors

-Several economic entities (producers) in this field.

-Technical and technological factors. Availability of agricultural machinery applied modern technologies (drainage and irrigation systems, chemicals, automation). Technology and technology improvement - the use of modern technology and high technology leads to increased labor productivity, which increases supply.

-Product price - there is a direct relationship between the price and supply reflected in the law of supply;

-Availability of fertilizers and drugs against diseases and pests: volume and cost

-Availability of seeds: cost and volume

-Producers' expectations regarding price increase

-Market demand.

Then, to be included in the model, the process of removing factors that do not meet several requirements is carried out by the

methodology of factor selection. Because some factors are of the same economic nature, some are at different hierarchical levels, and some, for several reasons, lack the necessary statistical data, it is considered appropriate to exclude them from the model [8].

In this regard, the following factors were selected to be included in the developed model:

-Sown area X_1; thousand ha.

-Fixed assets X_2; mln. man

-Labor resources X_3; thousand people

-Directed investment volume X_4; mln. Man

-Modeled indicator - gross agricultural output Y; mln. man

RESULTS AND DISCUSSIONS

The study started from the primary empirical data provided by the State Statistics Committee of the Republic of Azerbaijan as shown in Table 1. The period of analysis was 2000-2020 for which the official data were available.

Table 1. Dynamics of changes in gross agricultural output and factors affecting it in the period 2000-2020

Years	Gross output, mln. man (Y)	Sowing area, thousand ha (X1)	Fixed assets, Mln man (X2)	Labor resources, thousand people (X3)	The volume of directed investment, million man (X4)
2000	1,112.4	1,766.8	2,634.4	1,509.4	6.5
2001	1,242.2	1,775.9	2,694.3	1,521.7	8.3
2002	1,342.9	1,783.2	2,727.1	1,530.4	18.5
2003	1,450.5	1,785.6	2,764.7	1,546.1	37.4
2004	1,572.7	1,790.8	2,821.5	1,551.6	35.0
2005	1,844.8	1,797.6	3,004.6	1,573.6	40.7
2006	2,115.5	1,795.5	3,467.3	1,583.2	58.3
2007	2,918.6	1,808.4	4,150.2	1,597.6	243.3
2008	3,505.9	1,818.4	4,521.9	1,611.3	336.5
2009	3,805.5	1,832.5	4,868.1	1,628.6	266.6
2010	3,877.7	1,842.7	5,099.8	1,655.0	431.0
2011	4,525.2	1,843.8	5,271.4	1,657.4	437.3
2012	4,844.6	1,855.0	5,611.9	1,673.8	648.8
2013	5,244.6	1,884.3	5,852.3	1,677.4	574.3
2014	5,225.8	1,885.6	6,106.4	1,691.7	363.9
2015	5,635.3	1,897.5	6,355.2	1,698.4	355.4
2016	5.632.4	1,959.1	6,891.2	1,729.6	325.1
2017	6,580.0	2,054.7	7,141.2	1,752.9	617.8
2018	7,010.0	2,057.9	7,441.1	1,770.8	764.4
2019	7,836.7	2,056.5	8,317.4	1,777.7	769.5
2020	8,428.9	2,045.2	9,604.1	1,771.9	520.6

Source: Official data of the State Statistics Committee of the Republic of Azerbaijan [16].

Compiling a matrix using Excel is the next important step to perform correlation analysis whose results are presented in Table 2.

Table 2. Analysis of correlation coefficients

	Gross product	Sowing place	Fixed assets	Labor resources	Directed investments
Total product	1				
Sowing place	0.93581	1			
Fixed assets	0.99407	0.93154	1		
Labor resources	0.98534	0.93847	0.97495	1	
Directed investments	0.90133	0.82668	0.86399	0.90322	1

Source: Own calculations using the software MS Office Excel.

Pearson's analysis of correlation coefficients shows that each factor has a high impact on the total output of agribusiness. The correlation coefficient for each is higher than 0.6, r_{yx1}= 0.935, r_{yx2} = 0.994, r_{yx3} = 0.985, r_{yx4} = 0.901. However, their ratios X_2 and X_3 are relatively higher, which means that in agriculture there is a close relationship with the volume of gross output (Y factor), rather than the indicators of fixed assets and labor resources. In addition, the relationship between factors Y and X is assessed as directly proportional and high according to the Ceddok criterion.

The results of the regerssion analysis are shown in Tabel 3.

Table 3. Regression analysis

Regression analysis					
Multifaceted R (multiple R)			0.998177062		
R^2 determination coefficient			0.996357448		
Normalized R (normalized R)			0.99544681		
The standard error			154.1259923		
Observations			21		
Analysis of variance					
	f	**SS**	**MS**	**F**	**F-importance**
Regression	4	103,963,565.725	25,990,891.431	1,094.131	2.78022620860696E-19
Residue	16	380,077.144	23,754.821		
Total	20	104,343,642.869			

Source: Own calculations using the software MS Office Excel.

In the regression model, the coefficient of determination allows us to express that the gross agricultural output (supply) depends 99% on the factors included in the model, and 1% on the factors not included in the model. The multivariate correlation coefficient indicates that there is a close relationship between the factors studied. In addition, the actual value of the F-criterion is statistically significant, given that the given probability level exceeds the critical threshold.

Table 4.The result of a multiple regression model for factors influencing the efficiency of agricultural production

	Coefficient	**Standard deviation**	**T-statistics**	**P-importance**	**Low 95%,**	**Top 95%**
Intersection	-7,891.6187	3,090.2137	-2.5537	0.0212	-14,442.5792	-1,340.6581
X_1	0.3711	1.0165	0.3651	0.7198	-1.7837	2.5259
X_2	0.7974	0.0786	10.1479	2.2382	0.6307	0.9639
X_3	4.1589	2.2711	1.8312	0.0857	-0.6556	8.9736
X_4	1.1309	0.3178	3.5587	0.0026	0.4572	1.8045

Source: Own calculations using the software MS Office Excel.

As a result, the regression equation is expressed in the following form:

$$Y= -7,891.6187 + 0.3711x_1 + 0.7974x_2 + 4.1589x_3 + 1.1309x_4$$

According to the regression equation, 1 unit change of factor X_1 will cause 0.3711 units to change in factor Y, 1 unit change of factor X_2 will cause 0.7974 units to change in factor Y, 1 unit change of factor X_3 will cause 4.1589 units to change in factor Y, 1 unit change of factor X_4 will change 1.1309 units of factor Y.

To check the quality of the regression model, several important indicators were calculated and compiled in tabular form. The overall determination coefficient of the multivariate regression equation was 0.9963. Relevant indicators for each factor are also shown in the table. Given that the closer the coefficient of determination is to 1, the more the outcome

factor depends on the influence of the factors included in the model. Other indicators of the quality of the regression model include the Fisher and Student criteria. Here, as a result of a comparison of the critically developed criteria with the relevant indicators obtained, it is determined whether the model and the factor are statistically significant. Thus, for the model to be statistically significant, the actual F and T values for both indicators must be higher than the critical values. In addition, based on statistical data, it was determined that $F_{critical} = 3.01$ $T_{critical} = 2.473$.

To determine the real role of the factors influencing the supply in agribusiness, it is necessary to use relative indicators as well as absolute indicators. From this point of view, the elasticity coefficient characterizing the change of the resulting factor should be used for a 1% chance of the variable factor. The elasticity coefficient is considered to be one of the absolute conditions of the analysis in terms of determining this dependence. If the elasticity coefficient is less than 1, the effect on the resulting factor is not considered to be so high [10].

Table 5. Evaluation of quality criteria of the regression model

Indicators	**X_1**	**X_2**	**X_3**	**X_4**
F-Fisher criteria	67.553	3,113.166	689.834	505.972
T-student criteria	11.57	39.88	25.18	9.07
β coefficient	0.0164	0.713	0.159	0.128
Elasticity coefficient	0.17	0.998	1.674	0.0905

Source: Own calculations using the software MS Office Excel.

Looking at the elasticity coefficients, we can note that a 1% change in X_1 will lead to a 0.17% change in gross agricultural output, a 1% change in X_2, a 0.998% change in agricultural output, and X_3 change in 1.674%, and a 0.0905% change in X_4. The obtained coefficients of elasticity prove once again that the indicator of the availability of labor resources stands as the factor that has the greatest impact on the outcome factor. It is estimated that the approximation coefficient is 2.58%, which is less than 7%, indicating the high quality of the regression equation. According to the comparative analysis of the coefficients β, the highest $\beta_2 = 0.713$ means that the outcome factor Y is most affected by the factor X_2. According to the analysis of the autocorrelation coefficient, if the rei is less than <0.5, it means that there is no autocorrelation. According to the calculation of the standard error criterion of autocorrelation, there is no autocorrelation in the regression equation.

Another important issue is to check the autocorrelation between the remains. From this point of view, it is necessary to record the residual indicators obtained in the regression statistics table performed using the Excel program and the operations to be performed on them. However, it should be noted that in the effective model, there should be no autocorrelation between the residues. From this point of view, the implementation of the Darbin Watson and Brush Godfrey tests is important.

According to the analysis of the correlation between E_i and E_{i-1}, the correlation coefficient between the residues is -0.387. According to the Breuch Godfrey test, in order to test autocorrelation, it is first necessary to determine the actual (observed) value of the T criterion. According to the formula:

$$T= \frac{R*\sqrt{n-2}}{\sqrt{1-R^2}}$$

$$T= (-0.387*\sqrt{19})/\sqrt{(1-0.149} = 1.829$$

Then, using Excel, we determined the critical index to be equal to critical ≈2.08. Then the actual and critical indicators of the T criterion should be compared. If such a situation is observed in $T_{factual} > T_{critical}$, then we cannot accept the null hypothesis. The essence of the zero hypothesis is that there is an autocorrelation between the residues. If, on the contrary, the situation is observed, then it is possible to accept zero value. In our

example, the actual value is lower than the critical value, which means that there is no autocorrelation between the residues.

Further, in the regression analysis, it is necessary to specify the approximation coefficient, to determine the extent to which the calculated coefficients distort the calculated indicators from the actual indicators. If the average approximation error does not exceed 10-15%, it indicates that the developed model is of high quality. The following formulas are used to determine the average quantitative value of the approximation error:

Aj = (residual index/actual Y index) * 100 (1)

Coefficient A= = $\frac{1}{n}$*$\sum A_j$(2)

The results for the average approximation error are presented in Table 6.

Table 6. Calculation of the average approximation error

Y indicator-actual	**Predicted Y indicator**	**Residual indicator**	**A**
1,112.4	1,149.58600990122	37.1860099012208	3.34286317
1,242.2	1,253.91583549832	-11.7158354983226	0.943152109
1,342.9	1,330.49648256913	12.4035174308704	0.923636714
1,450.5	1,448.03738799281	2.46261200719437	0.169776767
1,572.7	1,515.41713994564	57.2828600543619	3.64232594
1,844.8	1,761.87948373026	82.9205162697356	4.494824169
2,115.5	2,189.86382288467	-74.3638228846694	3.515188981
2,918.6	3,008.26494943851	-89.6649494385088	3.072190415
3,505.9	3,470.72795293927	35.1720470607324	1.00322448
3,805.5	3,744.90542081455	60.5945791854538	1.592289559
3,877.7	4,229.15168533928	-351.451685339281	9.063405765
4,525.2	4,383.49136983589	141.708630164107	3.131544024
4,844.6	4,966.53524541581	-121.93524541581	2.516931128
5,244.6	5,099.81430825914	144.78569174086	2.760662238
5,225.8	5,124.43901713588	101.360982864116	1.939626141
5,635.3	5,345.48907160708	289.810928392923	5.142777286
5,632.4	5,891.22594706493	-258.825947064934	4.595304791
6,580	6,553.95913166465	26.0408683353489	0.395757877
7,010	7,034.50553979247	-24.5055397924716	0.34957974
7,836.7	7,767.16839927008	69.5316007299161	0.887256125
8,428.9	8,483.32579890038	-54.4257989003781	0.645704646
Total			**54.12802207**
Approximate coefficient			**2.5775248605**

Source: Own calculations using the software MS Office Excel.

Based on the analysis of the above table, we found that the approximation coefficient was 2.57%, which indicates the high quality of the regression equation and the model to be constructed.

In order to form an efficient production system in the agribusiness and identify the most important factors affecting the system at the next stages, determine the impact of their changes on production volumes and make effective decisions, the model should be based on a statistical and econometric analysis of external and internal factors of the enterprise environment [4].

Thus, due to several indicators identified as a result of econometric analysis, as well as the fact that the correlation coefficient for each factor and the overall model is greater than 0.9, the coefficient of determination for the overall model is 0.9963, the Fisher and Student coefficients are too high. Against the background of the restoration of the production potential of the agrarian sector of our country, future needs and the restoration of the agrarian sector in our liberated territories, optimization of arable lands, the level of fixed assets, labor resources in this area, as well as their professionalism, domestic and foreign investment. is highly

dependent, and this database will be used to forecast the future and build an effective supply model [2]. In agribusiness, it is important to make forecasts using econometric methods aimed at more rational use of production resources and optimization of production and processing of agricultural products, after determining the impact on the total output through the development of a regression model of production resources of different economic importance. is. Using Excel software, statistical forecasting for the next 11 years was performed based on the figures for 2000-2020 (Table 7).

Table 7. Forecasting gross agricultural production and its affecting factors

Years	Gross agricultural output, billion manat	Planting area, mln ha	Fixed assets, billion manat	Labor resources, million people	Fixed capital investment, mlnmanat
2022	8,445.295	2,053.543	8,977.739	1,811.946	768.3938
2023	8,808.783	2,068.572	9,299.907	1,825.997	805.2075
2024	9,172.271	2,083.601	9,622.075	1,840.047	842.0213
2025	9,535.759	2,098.631	9,944.244	1,854.098	878.8351
2026	9,899.247	2,113.66	10,266.41	1,868.148	915.6488
2027	10,262.73	2,128.689	10,588.58	1,882.199	952.4626
2028	10,626.22	2,143.719	10,910.75	1,896.25	989.2764
2029	10,989.71	2,158.748	11,232.92	1,910.3	1,026.09
2030	11,353.2	2,173.777	11,555.09	1,924.351	1,062.904
2031	11,716.69	2,188.806	11,877.253	1,938.402	1,099.717
2032	12,080.18	2,203.836	12,199.421	1,952.452	1,136.531

Source: Own calculations using the software MS Office Excel.

According to the analysis of the forecasted indicators, the gross agricultural output has a dynamics of growth. In 2032, compared to 2022, the corresponding indicator increased by 43% and amounted to 12.08 billion manats. The dynamics of growth of indicators were also observed on the factors affecting the gross agricultural output. Thus, compared to 2022, arable land increased by 7.3% in 2032, fixed assets by 36%, labor resources by 7.7%, and investments by 48%.

Table 8. The dynamics of the increase in indicators in the future in relation to the current indicators, in percent

Factors	Actual indicators			Predicted indicators		Predicted growth rate in 2032 compared to 2020 and 2025, in %	
	2010	2015	2020	2025	2032	2020	2025
Gross agricultural output, billion manat	3.8	5.6	8.4	9.5	12.08	43.8	26.7
Planting area, mln ha	1.8	1.9	2.04	2.09	2.2	7.8	5.01
Fixed assets, billion manat	5.1	6.3	9.6	9.9	12.2	27.1	22.7
Labor resources, million people	1.6	1.7	1.8	1.8	1.9	10.2	5.3
Fixed capital investment, mln manat	431	355	520.6	878.8	1136.5	118.3	29.3

Source: Own calculations using the software MS Office Excel.

Based on the analysis presented in Table 8, it can be determined that to increase the gross agricultural output in the long –term, an important task for the government is to increase investment in fixed assets and improve the equipment of fixed assets. In general, it can be concluded that as a result of increasing various indicators, gross agricultural output is projected to increase by 43.8%. At the same time, it is necessary to optimize several other quality indicators when identifying opportunities to increase

productivity in the agricultural sector. In this regard, raising the level of wages of agricultural workers, increasing the professionalism of workers, more rational use of arable land in a scientifically sound manner, improving the organization of production and labor, increasing the intensity of fixed assets, diversifying production and deepening specialization, progress in livestock and crop production and the application of resource-saving technologies and other organizational, economic and social processes.

CONCLUSIONS

Thus, the above classification of factors for increasing the efficiency of agricultural production proposed by us allows us to accurately assess the place and importance of each factor in the results of agricultural business activities, as well as choose the most optimal way to achieve goals. Accounting and systematic use of the most important factors for increasing productivity make it possible to successfully overcome emerging economic difficulties, find priority areas for development, and quickly form competitive production. Economic forecasting of these factors for the next 10 years will help redirect the government's efforts to the most priority areas, thereby improving agricultural policy. At the same time, it should be borne in mind that all these factors are applicable in combination, some factors can compensate for others, however, it should be remembered that ignoring individual factors or downplaying their importance will curb the overall growth in production efficiency and will not bring the desired comprehensive effect.

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