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RESEARCH ARTICLE

EMPIRICAL ANALYSIS OF THE CONTRIBUTION OF AGRICULTURE TO NATIONAL ECONOMIC DEVELOPMENT

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Abstract

The article is devoted to econometric models of increasing agriculture's contribution to the national economy's development through state support of investments. Based on the econometric equation of the ARDL model, a forecast for the study was developed using the ARIMA model.

Introduction:-

The Food and Agriculture Organization of the United Nations (FAO) admits that taking into account the latest forecasts, to meet the growing demands of the world population by 2050, it will be necessary to increase the consumer products produced in agriculture by almost 50% compared to 2012 [1, FAO, 2021.]. According to the International Fund for Agricultural Development (IFAD) and the World Food Security Program (WFP), investments for the development of the sector and social spending of the state until 2030 do not create opportunities for a consistent increase in incomes and adequate consumption of food products by all social strata of the population. unable to prevent large-scale hunger problems[2. FAO, IFAD & WFP. 2015]. To prevent these problems until 2030, according to forecasts, 265 billiondollars requires additional investment. The intended investments mainly require intensive development through the wide implementation of innovative projects such as "Smart Agriculture", and "Digitalization of Agriculture" and the introduction of modern methods of state support of the network in this direction. In the course of the dissertation research, we set the task of determining the forecast indicators of the target parameters of the share of the gross added value of the agricultural sector in GDP as the main macroeconomic indicator of agricultural development.The annual growth rate of agricultural production (X1) and the growth rate of investments in agricultural fixed capital (X2) were selected as factors influencing this target parameter. Prospective parameters determined by the increase of the share of the gross added value of the agricultural sector in the GDP are influenced differently by the annual growth trend of the gross added value of the sector. Because the share of the gross added value of the agricultural sector in the GDP is ensured not only by the added value of the agricultural sector but also by the rate of growth of the added value in the industry and services. Therefore, the extent to which the annual growth of the gross added value is ensured, and the study of its effect was chosen as a factor in the work. In the national economy, the annual growth rate of agricultural production and investments in agricultural fixed capital leads to an increase in the growth rate of the share of GDP in agriculture, and there is a strong connection between these economic indicators.

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The result of econometric equations is the growth rate of the gross added value of the agricultural sector in the Gross Domestic Product (GDP) during the period 2000-2021. The factors include the annual growth rate of agricultural production and the growth of investments in agricultural fixed capital during the period 2000-2021. The pace was taken.

Literature Review:-

Econometric equations developed based on time series data on the VAR (Vector Autoregressive) model have been developed and defined by many foreign scientists.In time series, the VAR (Vector Autoregressive) model is defined in econometrics with a lag, that is, by calculating the changes of the previous step [3. Emeka Nkoro, Aham Kelvin Uko 2016.]. According to him, the dependence represents the need to apply the VAR model. VAR is a vector auto auto-regression that includes lags of the outcome variable.The VAR (Vector Autoregressive) model is widely used in time series research to study the dynamic relationship between variables that interact with each other. In addition, they are important forecasting tools used by most macroeconomic indicators[4. Allen, G. P., and R. Fildes. 2005.].

The development of these models is the subject of many ongoing studies after the important contribution of the European scientist Sims (5. Sims, Christopher A. 1972), who laid the foundation for modeling endogenous variables in a multivariate setting.After developing this framework, a series of statistical tests were obtained to determine the nature of the interdependence and dynamic relationships between the variables.In addition, the latest developments include the use of structural decomposition, sign restrictions, the introduction of time-varying parameters, structural breaks, and econometric indicators such as stochastic volatility [5. Sims, Christopher A. 1980.].The structure of VAR (Vector Autoregressive) models allows us to explain the values of endogenous variables from their previously observed values[6. Banerjee, A., J. Dolado, J. Galbraith, and David F. Hendry. 1993.].VAR (Vector Autoregressive) models are used for multivariate time series. The structure is that each variable is a linear function of its past lags and the past lags of the other variables.Also, according to the scientific innovations created by European scientists Engle and Granger, economic studies are provided with powerful tools for modeling cointegrated relationships between variables [7. Engle, Robert F., and Clive W. J. Granger. 1987.].

According to foreign scholars Ghulam Ghouse and Saud Ahmed Khan, the ARDL methodology follows general-specific assumptions and is based on solving many econometric problems such as misidentification and autocorrelation, and developing the most suitable interpretable model [8. Ghulam Ghouse, Saud Ahmed Khan, Atiq Ur Rehman 2018]. Many studies have used the Johansen integration technique to identify long-run relationships between variables of interest through the ARDL model[9. Pahlavani, Mosayeb; Wilson, E.; and Worthington, A.C. 2005].Also, according to the European economist Perron, if one is not sure about the unit root properties of empirical data, the use of the ARDL procedure is the most suitable model for empirical work[10. Perron (1997).In the ARDL model, the resulting symbol is represented by the lag and current values of the factor symbol and its lag value.The autoregressive distributed lag (ARDL) model is one of the most common dynamic unrestricted models in the econometric literature.Since each of the main variables is represented as a single equation, indigeneity is less of a problem in the ARDL model because it is free of residual correlation (ie, all variables are assumed to be endogenous). It also allows us to analyze the reference model.

When there is a long-term relationship, ARDL can distinguish between dependent and explanatory variables in the model. That is, in the ARDL model, the approach assumes that there is only one reduced equation relationship between the dependent variable and the exogenous variables [11. M.H. Pesaran, R.J. Smith and Y. Shin, Bounds].

According to Pesaran, a foreign economist, the ARDL approach should be followed in two stages. In the first step, the existence of any long-term relationship between the variables of interest is determined using the F-test, in the second step, the coefficients of the long-term relationship are estimated and their values are determined, and then the short-term elasticity of the variables is evaluated in the form of error correction of the ARDL model [12. Pesaran, H. M. and Pesaran, B. (1997)].We introduce the following notation to describe the use of multivariate time series. In its basic form, according to the VAR model $\mathbf{y_t = (y_{it},\ldots,y_{kt},\ldots y_{Kt})}$ **k=1.....K** consists of a set of endogenous variables. After adding **p** lags of endogenous variables, the VAR(p) model can be defined as according to

$\mathbf{y_t = A_1 y_{t-1} + \ldots A_p y_{t-p} + CD_t + u_t}$ (1)

Here **Ai**is the **(K×K)**coefficient matrices for $\mathbf{A_i}$ **i=1,… p** i=1,…**p**, and $\mathbf{u_t}$ is the time-invariant positive definite covariance matrix of K-dimensional coefficient exponent [13. Granger, Clive W. J. 1969.]. In multivariate time series, the VAR (Vector Autoregressive) model extends the idea of univariate autoregression to **k** time series regressions, where the lagged values of all **k** series appear as regressors[14.]. In other words, in the VAR (Vector

Autoregressive) model, we regress the vector of time series variables on the lagged vectors of these variables. As for **AR(p)**models, the lag order is determined by p, so the VAR**(p)** model of two variables $\mathbf{X_t}$and $\mathbf{Y_t}$ **(κ=2)**is given by Eqs.
According to him,

$$\mathbf{Y_t = \beta_{10} + \beta_{11} Y_{t-1} + ... + \beta_{1p} Y_{t-p} + \gamma_{11} X_{t-1} + ... + \gamma_{11} X_{t-p} + u_{it}} \quad (2)$$

$$\mathbf{X_t = \beta_{20} + \beta_{21} Y_{t-1} + ... + \beta_{2p} Y_{t-p} + \gamma_{211} X_{t-1} + ... + \gamma_{2p} X_{t-p} + u_{2t}} \quad (3)$$

βand**γ**can be estimated using OLS in each equation. Estimates for VAR (Vector Autoregressive) are time series estimates introduced in the basic concept applied to each equation.

Research Methodology:-

According to our research, since the empirical data is formed based on time series data, VAR (Vector Autoregressive) and ARDL (Autoregressive Distributed Lag) models were used in the development of econometric models. Based on the econometric equation of the ARDL model, a forecast for the study was developed using the ARIMA model.

Analysis and Results:-

According to our research, in the development of the VAR (Vector Autoregressive) model, we checked the conditions of integrating time series in the following order.

1. Indicators are logarithm zed.
2. Time series were checked for stationarity.
3. A regression model was built.
4. Gaussian Markov conditions were checked.

According to the econometric equation, the variables were expressed as follows
Y = growth rate of the share of GDP in agriculture
X1 = growth rate of agricultural production
X2 = growth rate of investment in agricultural fixed capital

According to our research, the analytical graphic table of the composition of the growth rate of the share of GDP in agriculture, the growth rate of agricultural production, and the growth rate of investments in agricultural fixed capital for the years 2000-2021 were as follows. (See Figure 1)

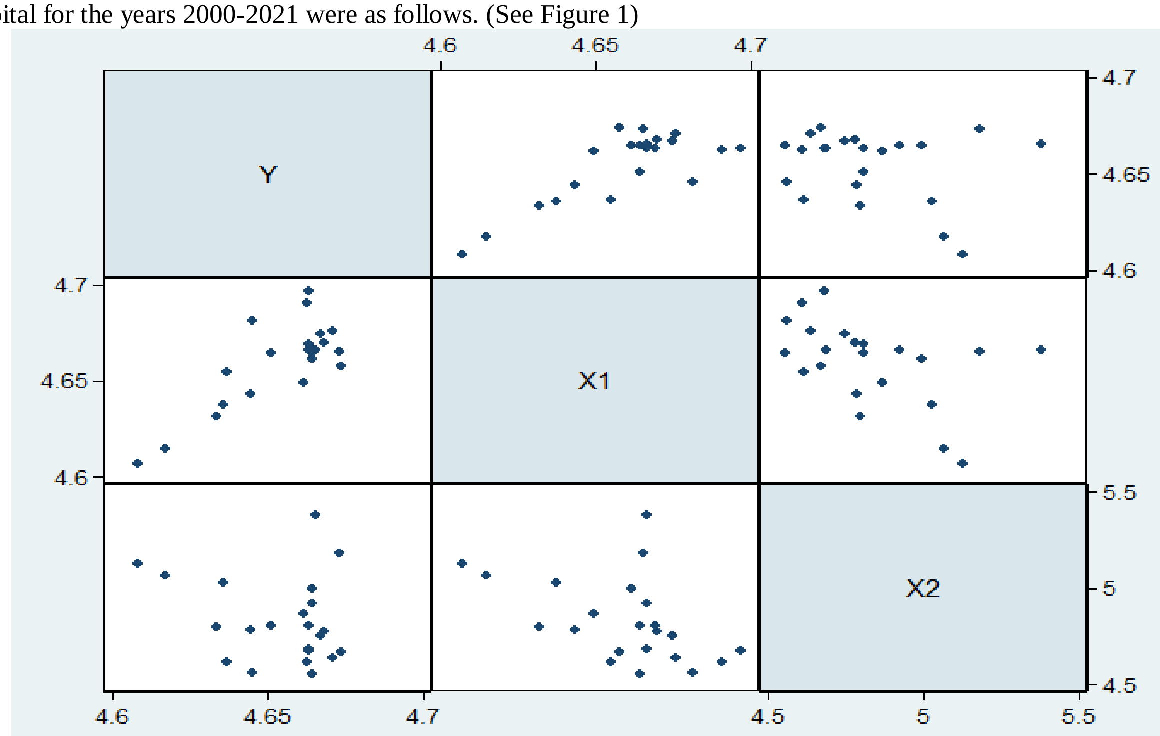

Figure 1:- A graphical matrix of the relationship between the resultant and factor signs.

According to the graphic analysis of Figure 1, the growth rate of the share of the gross added value of the agricultural sector in GDP, the annual growth rate of agricultural production, and the growth rate of investments in agricultural fixed capital are density on the graphic matrix, which represents the relationship between them. From Table 1, the VAR (Vector Autoregressive) model in the regression equation produced values of 0.73 and 0.01, respectively, while the standard errors were 0.12 and 0.01.

1-table:- VAR (Vector Autoregressive) regression model exponents of Eq[1].

lnY	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnX1	.735	.126	5.82	0	.471	.999	***
lnX2	.016	.013	1.23	.032	-.011	.044	
Constant	.381	.205	1.86	.078	-.047	.81	*
Mean dependent var	1.538	SD dependent var	0.004				
R-squared Adj R-squared	0.660 0.624	Number of obs	22				
F-test	18.463	Prob > F	0.000				
Akaike crit. (AIC)	-200.255	Bayesian crit. (BIC)	-196.982				
*** p<.01, ** p<.05, * p<.1							

Also, the actual value in the ANOVA table was high, F=18.46.

R-squared=0.66 and adjusted coefficient of determination Adjusted R^2=0.62 in the ANOVA table gave a positive value for the quality of the given model.According to our research, VAR (Vector Autoregressive) model in the regression equation H0:y=0, H1:y≠0 F<0.05 and t<0.05, the main hypothesis is not meaningful H0:y=0 and we reject the main hypothesis and move to the alternative hypothesis and in this case, the alternative hypothesis H1:y≠0 is statistically significant.

The VAR (Vector Autoregressive) model developed according to our research was as follows.

$$\mathbf{LnY=0.73lnX_1+0.01lnX_2+0.38} \quad (4)$$

In developing the econometric model for the study, we constructed the ARDL model, which was expressed as follows.

$$\Delta Y_t = \beta 1 Y_{t-1} + \beta 2 X1 + \beta 3 X2 + u_t$$ [15. D. Asteriou and S. G. Hall. 2007] (5)

Here: Δy_t _ is the growth rate of the share of gross added value of the agricultural sector in GDP.

$\beta 1 y_{t-1}$- Growth rate of the share of gross added value of the agricultural sector in the GDP of a year ago.

$\beta 2 x1$ - Annual growth rate of agricultural production.

$\beta 3 x2$ - Growth rate of investments in agricultural fixed capital.

$u_t$is the value of errors between years.

The econometric equation of the **ARDL** model for the study was developed based on the Stata program.

2-table:- ARDL regression model exponents of Eq[2].

Y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
L	.324	.143	2.27	.003	.022	.626	**
$\mathbf{X_1}$	.552	.134	4.13	.001	.27	.834	***
$\mathbf{X_2}$	.008	.012	0.67	.011	-.017	.033	
Constant	.535	.662	0.81	.43	-.86	1.931	
Mean dependent var	4.655	SD dependent var	0.018				
R-squared	0.739	Number of obs	21				
F-test Adj R-squared	16.079 0.693	Prob > F	0.000				
Akaike crit. (AIC)	-130.007	Bayesian crit. (BIC)	-125.829				
*** p<.01, ** p<.05, * p<.1							

[1]It was developed independently by the author based on the Stata program

[2]It was developed independently by the author based on the Stata program

According to Table 2, the factor symbols in the ARDL model regression equation were 0.32, 0.55 and 0.07, respectively, while the standard errors were 0.14, 0.13 and 0.01. Also, the actual value in the ANOVA table was F=16.08. The ARDL table has R-squared=0.73 and the adjusted coefficient of determination Adjusted R^2=0.69, which means that the quality of this model is positive.In our study, ARDL model regression equation H0:y=0, H1:y≠0 F<0.05 and t<0.05, the main hypothesis is not meaningful H0:y=0 and we reject the main hypothesis and move to the alternative hypothesis and in this case the alternative hypothesis is H1 :y≠0 resulted in statistical significance.

The ARDL model equation developed according to our research is as follows.

$$\mathbf{Y = 0.32Y_{t-1} + 0.55X_1 + 0.07X_2 + 0.53} \quad (6)$$

Based on the ARDL model equation developed above, we developed forecasts for the next five years using the ARIMA model.ARIMA (Autoregressive Integrated Moving Average) model is a statistical analysis model using time series data to forecast future economic trends.Forecasting of economic indicators is checked and analyzed based on the methodology of Box Jenkins, a European scientist. They are as follows: 1. Identification. 2. Estimation. 3. Forecasting

The ARIMA model equation looks like this:

$$\mathbf{Y_t} = c + \sum_{i=1}^{p} \boldsymbol{\alpha}\, \mathbf{Y_{t-1}} + \sum_{j=1}^{q} \boldsymbol{\theta}\, \mathbf{E_{t-j}} + \mathbf{E_t} \quad (7)$$

According to the above econometric equation, c-constant, p-auto regression order, q-average moving order and e-residual indicators are calculated.Several options were used in the precise selection of the ARIMA model, and the ARIMA model (Table 3) was selected as the most appropriate model.The econometric equation of the ARIMA model for the study was developed based on the Stata program.

3-table:- ARIMAregression model exponents of Eq[3].

D.Y	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Constant	.026	.525	0.05	.961	-1.004	1.055	
L	-.636	.483	-1.32	.187	-1.583	.31	
L2	-.293	.412	-0.71	.477	-1.101	.515	
L	1	.	10.	.	.	.	
Constant	1.227	.169	7.25	0	.895	1.559	***

Mean dependent var	0.038	SD dependent var	1.556
Number of obs	21	Chi-square	1.780
Prob > chi2	.	Akaike crit. (AIC)	78.897

*** p<.01, ** p<.05, * p<.1

The econometric equation of the ARIMA model for forecasting the time series according to Table 3 is as follows.The ARIMA (2,1,1) model equation

$$\mathbf{Y = 0.2 - 0.63_{t-1} - 0.29_{t-2} + 0.99e_{t-1}} \quad (8)$$

In the next step, this model is tested under two conditions.
Condition 1 – the residuals must be stationary.
Condition 2 – The AR and MA residuals of the ARIMA model must be within the unit circle or the values must be less than 1.

The first condition was tested in two different ways. Graphical and multivariate (multivariate portmanteau white noise tests) vibration detection tests are performed.

[3]It was developed independently by the author based on the Stata program

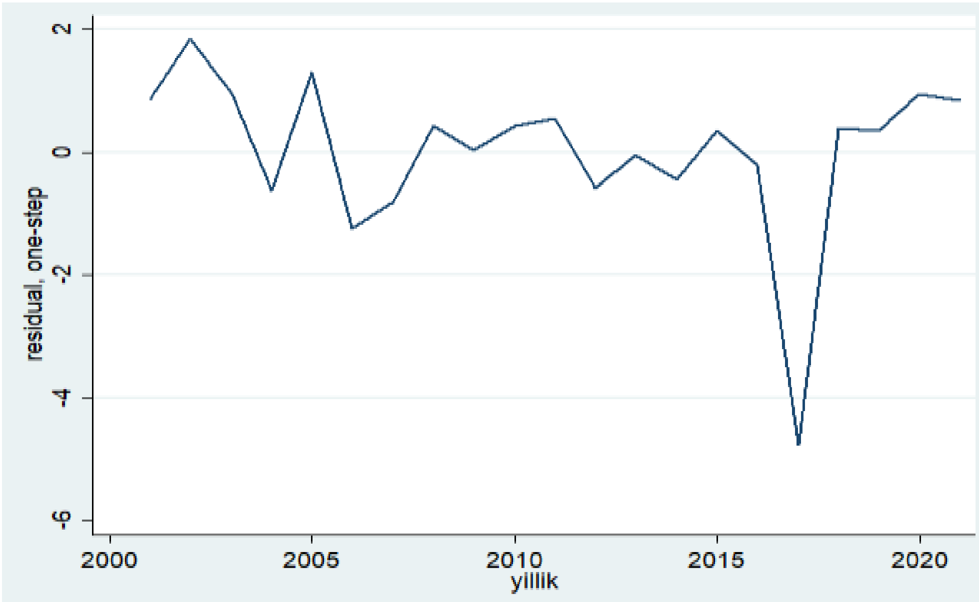

Figure 2:- A plot of the stationarity of the residuals of the ARIMA (2,1,1) model.

According to the ARIMA (2,1,1) model graph in Figure 2, the mean of the residuals is almost equally distributed. In the second method of the first condition, i.e. multivariate (multivariate portmanteau white noise tests), a vibration detection test is conducted.As a result, p-value was greater than 0.05 (p= 0.78). So, this model passed the first condition in both ways.The second condition was that the value of AR was less than 1, 0.54, and it was placed in a circle.

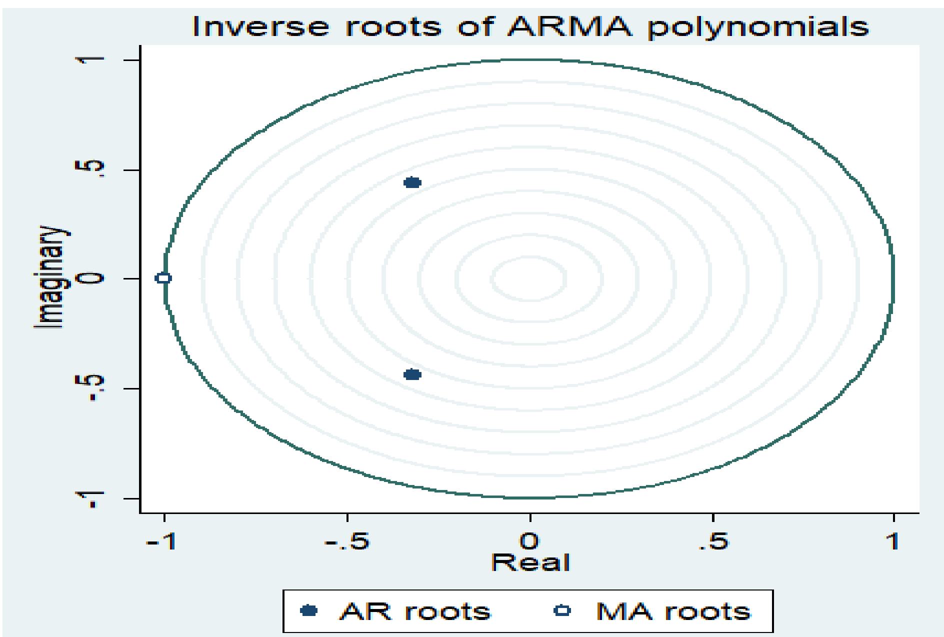

Figure 3:- The area of AR values according to the ARI (1,1,0) model.

The growth rate of the share of the gross value added of the agricultural sector in GDP from 2022 to 2026 through the ARIMA (2,1,1) model using the Stata program for the study without taking into account the random factors, two-factor indicators are the growth rate of the production of agricultural products and the agricultural fixed capital A forecast of the investment growth rate was developed. The forecast result is shown in Table 4 below.

Table 4:- Forecast indicators of the growth rate of the share of the gross added value of the agricultural sector in GDP for 2022-2026.

Years	The growth rate of the share of gross added value of the agricultural sector in GDP (in percent)	Years	The growth rate of the share of gross added value of the agricultural sector in GDP (in percent)
2000	103,2	**2014**	106
2001	104,1	**2015**	106,1
2002	106	**2016**	106,2
2003	106,8	**2017**	101,2
2004	105,9	**2018**	100,3
2005	107,1	**2019**	103,1
2006	106,5	**2020**	102,9
2007	104,7	**2021**	104
2008	105,8	**2022**	104.21
2009	106,1	**2023**	103.80
2010	106,1	**2024**	104.06
2011	107	**2025**	104.70
2012	106,4	**2026**	104.03
2013	106		

Conclusion:-

The following proposals and recommendations were developed as a result of the analysis and conclusions of the analysis and conclusions of the study of the interaction of these factors: the increase in the growth rate of the share of the gross added value of the agricultural sector in the GDP, the growth rate of the production of agricultural products and the increase in the growth rate of investments in agricultural fixed capital.

1. VAR model equation The econometric model of VAR (Vector Autoregressive) $LnY=0.73lnX_1+0.01lnX_2+0.38$ was expressed in this form. According to this model, an increase in the growth rate of agricultural production by 1% leads to an increase in the growth rate of the share of the gross added value of the agricultural sector in GDP by 0.73%. A 1% increase in the growth rate of investment in agricultural fixed capital leads to a 0.01% increase in the growth rate of the share of GDP in agriculture.

2. According to the regression equation of the ARDL model $Y=0.32Y_{t-1} +0.55X_1+ 0.07X_2 + 0.53$, a 1 percent increase in the share of the gross added value of the agricultural sector in the GDP leads to an increase in the growth rate of the share of the gross added value of the agricultural sector in the GDP by 0.32 percent. An increase in the annual growth rate of agricultural production by 1% leads to an increase in the growth rate of the share of the gross added value of the agricultural sector in GDP by 0.55%. A 1% increase in the growth rate of investments in agricultural fixed capital leads to a 0.07% increase in the share of the gross added value of the agricultural sector in GDP.Also, in our study, the growth rate of the share of the gross added value of the agricultural sector in the GDP was developed by analyzing the forecasts for the next five years using the ARIMA model for the annual growth rate of agricultural production and the growth rate of investments in agricultural capital.

3. ARIMA model equations ARIMA (2,1,1) model equation. Using the equation $Y = 0.2 - 0.63_{t-1}$-0.29_{t-2}+$0.99e_{t-1}$in the national economy in 2022-2026, the growth rate of the share of gross added value of the agricultural sector in GDP is random without taking into account the factors, it was predicted to be 104.21% in 2022, 103.80% in 2023, 104.06% in 2024, 104.70% in 2025 and 104.03% in 2026.

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