The European Proceedings of
Social & Behavioural Sciences
EpSBS

Future Academy

ISSN: 2357-1330

https://dx.doi.org/10.15405/epsbs.2019.03.02.255

SCTCMG 2018
International Scientific Conference "Social and Cultural Transformations in the Context of Modern Globalism"

ECONOMETRIC METHODS FOR ASSESSING DEVELOPMENT OF AGRICULTURE IN CHECHEN REPUBLIC

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Abstract

To deepen quantitative analysis, the article uses econometric methods for assessing the state of the agricultural industry in the Chechen Republic. The purpose of the study is to predict consequences of institutional changes in the agriculture industry of the Chechen Republic. The results made it possible to predict further development of the industry and substantiate possibilities for improving financial efficiency of agricultural production. Econometric analysis is applied to the structure of the agriculture and dynamics of individual factor components. The results of correlation and regression analysis are an effective tool for planning and forecasting activities within the agricultural sector. Severe competition, attempts to form additional price and non-price competitive advantages require expanding opportunities for increasing the economic potential of agricultural production. The model of multiple regression was used as a model for the price volume of agricultural production. The assessment results for regression equation coefficients showed a correct statistically significant dependence on the selected parameters.

Keywords: Chechen Republic, agriculture, econometric assessment, forecasting.

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eISSN: 2357-1330

1. Introduction

The agricultural sector plays a leading role in the economy of the Chechen Republic. A tenth of the production assets are involved in the agriculture of the region. The share of agriculture in the GRP of the Chechen Republic was 9% (2016). At the beginning of 2017, more than 65% of the population of the Chechen Republic and 51% of the population of the North Caucasus Federal District (NCFD) lived in rural areas. In Russia, this share is less than 26%. (Melnikov, Sidorenko, Snimshchikova, & Mihailushkin, 2016).

As can be seen, restoration and development of the economic and social potential of agriculture is a must for economic growth of the Chechen Republic and other republics of the North Caucasus Federal District. However, in the 1990s, two events influenced the current state and trends in the agrarian sector. These are hasty market reformation of the economy (denationalization and privatization of property) and a military conflict which began in 1991 and affected the neighboring republics. As a result, in most republics of the North Caucasus Federal District, economic indicators of the agricultural industry lag behind the average rates for Russia, the North Caucasus Federal District and neighboring Stavropol Region. The situation has not changed significantly despite government support of the agricultural sector. (Avtorkhanov, 2007).)

2. Problem Statement

To deepen quantitative analysis, we use econometric methods for assessing the state of agriculture in the Chechen Republic. The results can be used to predict further development of the industry and substantiate possibilities of improving the financial efficiency of agricultural production.

3. Research Questions

Using the methods of econometric analysis, we analyzed the structure of the agriculture industry in the Chechen Republic with regard to the dynamics of its factor components.

4. Purpose of the Study

The purpose is to predict consequences of institutional changes in the agriculture industry of the Chechen Republic.

5. Research Methods

The traditional methods of statistical and economic analysis, comparative, structural, index, graphic, factor, correlation, regression, and other methods of economic statistics were used (Kusakina, 2015).

6. Findings

The results of correlation and regression analysis are an effective tool for planning and forecasting agricultural activities. Strong competition, attempts to form additional price and non-price competitive advantages require increasing the economic potential of agricultural production. A multiple regression model was used as a model for the price volume of agricultural output:

$$y = x\beta + \varepsilon,$$

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where x is the vector of variables of the regression model. To build and analyze adequacy of models, we used Eviews. Table 1 shows main parameters of the agricultural industry in the Chechen Republic for 2005-2016. (Basovskiy, 2004; Usenko, 2010).

Table 01. The main parameters of agricultural production in the Chechen Republic for 2005-2016.

Years	Agricultural products, million rubles, Y	Number of agricultural workers, thousand persons , x_1	Investment in agriculture, million rubles,	Size of crop area under grain and leguminous crops, thousand ha	Grain yield, centners per ha	Consumption of food per one head, centners	Mineral fertilizers (100% nutrients), kg / ha	Number of cattle, thousand heads	Number of sheep and goats, thousand heads	Milk yield per cow, kg
2005	4552	8.7	578.8	104.7	11.7	21.7	2.4	196.2	170.1	971
2006	5277	7.4	30.5	126.6	13.2	21.6	3.3	203.6	165.7	2152
2007	6921	37.1	205.1	101.5	14.0	21.2	0.3	232.5	196.9	2233
2008	8547	40.4	906.8	102.0	16.5	19.9	3.6	234.3	237.0	2223
2009	10380	33.1	965.7	99.2	17.0	22.2	10.4	224.7	213.5	2294
2010	10993	41.6	391.2	111.5	16.7	24.7	17.4	210.7	194.5	2457
2011	12897	61.4	835.5	138.1	20.5	23.7	29.6	222.1	215.5	2555
2012	13605	60.0	466.9	117.4	16.0	24.3	19.6	223.3	210.1	2564
2013	14706	63.9	689.7	104.7	17.7	21.7	15.1	237.6	217.2	2570
2014	15250	80.3	272.4	126.6	16.7	21.7	17.8	242.9	229.2	2551
2015	17704	90.9	1376.2	101.5	19.5	26.1	20.1	239.3	236.2	2556
2016	20121	97.6	6713.7	149.0	24.3	33.9	24.2	245.1	253.2	2633

For model purity, let us single out the factors affecting the function under consideration. To this end, we will construct a matrix of paired correlation coefficients (Table 2). Analysis of the matrix allows us to conclude that the influence of the factor in the third column (size of the grain and leguminous crop area) on the dependent value (agricultural production) is insignificant which resulted from the uneven and disproportionate growth of this parameter. Given this fact, we introduced a new indicator – gross yield of cereals and leguminous crops, thous. cent.:

*[Gross yield, thousand cent.] = [Size of the crop area, thousand ha] * [Grain yield, cent./ha].*

Table 02. Matrix of paired correlation coefficients

	Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8	Column 9
Column 1	1								
Column 2	0.96949741	1							
Column 3	0.615349701	0.564826264	1						
Column 4	0.426414413	0.394749067	0.5719408	1					
Column 5	0.875198435	0.837538697	0.7653464	0.55869403	1				
Column 6	0.713979884	0.642223378	0.8986339	0.61840409	0.77787751	1			
Column 7	0.824435824	0.768029516	0.4108366	0.59908685	0.8074631	0.6189585	1		
Column 8	0.756951268	0.836857546	0.4427771	0.13198915	0.66599796	0.3341354	0.3878965	1	
Column 9	0.826588239	0.866686507	0.600196	0.23201205	0.82575321	0.4986561	0.55745836	0.899524	1

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We will also consider livestock of cattle, sheep and goats as one indicator. Table 3 is used for econometric analysis.

The following notation is used:

Y — agricultural products, mln. rubles;

x_1 — number of agricultural workers, K people;

x_2 — investment in the agricultural industry, mln. rubles;

x_3 — gross yield of grains and leguminous crop, thous. cent.;

x_4 — consumption of food per 1 head, cent.;

x_5 — mineral fertilizers, kg/ha;

x_6 — number of cattle, sheep and goats, thous. heads;

x_7 — milk yield per cow, kg;

ε — random component.

Table 03. The main parameters of agricultural production in the Chechen Republic for 2005-2016 used for the econometric model

Years	Agricultural products, million rubles, *Y*	Number of agricultural workers, thousand persons , x_1	Investment in agriculture, million rubles, x_2	Gross harvest of grain and leguminous crops, thousand centner, x_3	Consumption of food per one head, centners x4	Mineral fertilizers (100% nutrients), kg / ha,, x5	Number of cattle, sheep and goats, thousand heads, x6	Milk yield per cow, kg, x7
2005	4552.00	8.70	578.80	1224.99	21.70	2.40	366.30	971.00
2006	5277.00	7.40	30.50	1671.12	21.60	3.30	369.30	2152.00
2007	6921.00	37.10	205.10	1421.00	21.20	0.30	429.40	2233.00
2008	8547.00	40.40	906.80	1683.00	19.90	3.60	471.30	2223.00
2009	10380.00	33.10	965.70	1686.40	22.20	10.40	438.20	2294.00
2010	10993.00	41.60	391.20	1862.05	24.70	17.40	405.20	2457.00
2011	12897.00	61.40	835.50	2831.05	23.70	29.60	437.60	2555.00
2012	13605.00	60.00	466.90	1878.40	24.30	19.60	433.40	2564.00
2013	14706.00	63.90	689.70	1853.19	21.70	15.10	454.80	2570.00
2014	15250.00	80.30	272.40	2114.22	21.70	17.80	472.10	2551.00
2015	17704.00	90.90	1376.20	1979.25	26.10	20.10	475.50	2556.00
2016	20121.00	97.60	6713.70	3620.70	33.90	24.20	498.30	2633.00

(Statistical compilation by the Ministry of Agriculture, 2016; Chechen statistics, 2017)

Figure 1 shows the dynamic range of the main dependent indicator – agricultural products.

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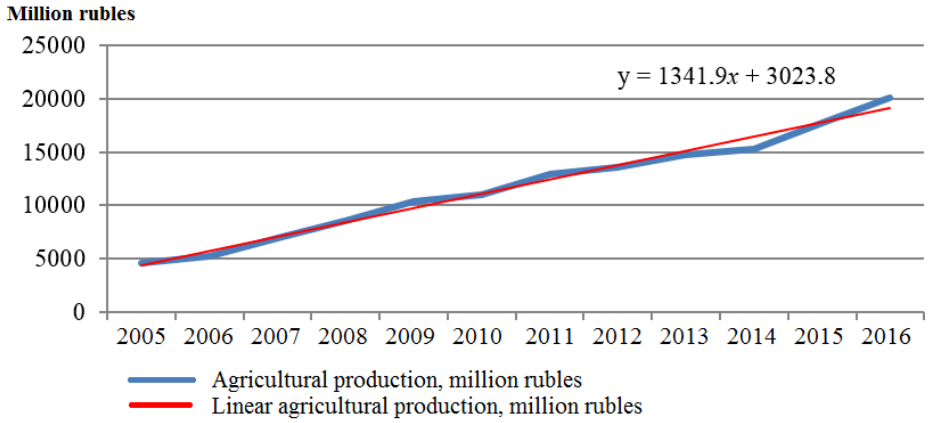

Figure 01. Dynamic changes in agricultural production of the Chechen Republic (million rubles) for 2005–2016

The graph of the dynamic range coincides with the linear trend line under the active growth trend. Since the beginning of 2014, acceleration has been observed. It should be noted that the number of people employed in agriculture has the strongest influence on the dependent value. Let us analyze the impact of this indicator.

$$Y = 161.7816x_1 + 3355.01.$$

For the resulting equation, the index of determination $D = R^2$, fixing the share of the explained variation of the effective feature due to the factors accounted for in the regression, is 0.939. The regression equation is adequate. It is important to take into account unevenness and intermittency of data and characteristics and interrelationship of agricultural indicators.

Let us build the model of paired regression for Y, x_2. For a more qualitative study, let us build a factor dynamics series x_2:

$$Y = 0.4608\, x_2 + 40826.61.$$

The coefficient of determination for this equation is 0.99 which speaks for a very high quality of the regression equation. Let us build a paired regression model for Y, x_3.

Figure 2 shows a non-uniform growing trend of an increase in the gross yield of cereals and legumes.

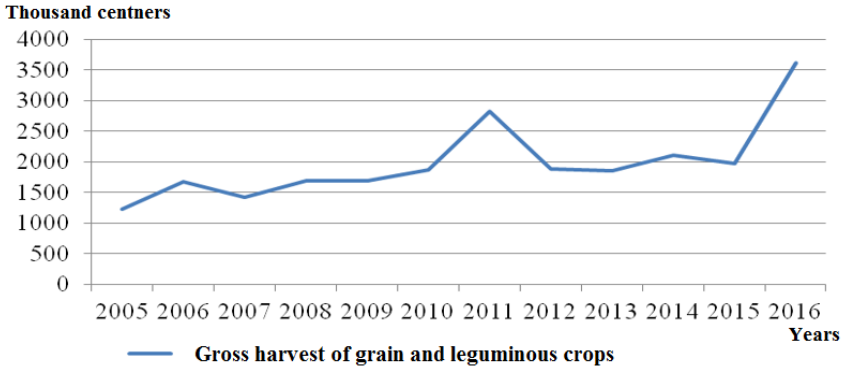

Figure 02. Gross harvest of grain and leguminous crops in the Chechen Republic (thousand centners for 2005–2016

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Based on the econometric analysis, we have a model

$$Y = 3.0038\ x_3 + 6782.15.$$

The determination coefficient value 0,828 means that an increase in the dependent variable by 82.8% is determined by an increase in the factors included in the model. The following model will be based on factors and conditions related to artificially stimulating growth in various agricultural areas (the use mineral fertilizers and feed consumption). Given the number of observations, the regression function can have no more than three variables.

The results of evaluation of regression equation coefficients show the correct statistically significant dependence on the selected indicators:

$$Y = 316.53\ x_4 + 315.856\ x_5.$$

The determination coefficient for this equation is 0.91 which speaks for good selection of the regression equation. Let us consider the latest regression model whose free components are the livestock of cattle, sheep and goats and milk yield. The factors are combined on several grounds: first, to determine the prospects for development of regional agriculture; second, these components depend on veterinary and zootechnical control and maintenance measures. (Israilov, 2013).

Figure 3 shows that there is an unstable step-wise trend at the first stage of the period. Since 2010, equalization of indicators with a predominance of an uptrend has been observed.

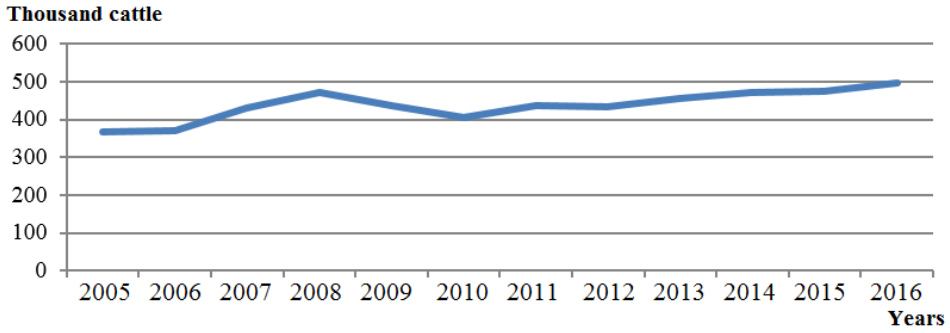

Figure 03. Dynamic changes in the number of cattle, sheep, goats in the Chechen Republic for (thousand cattle) for 2005-2016

Econometric calculation allowed for the following regression equation:

$$Y = 57.186\ x_6 + 20.4388\ x_7 - 63088.5.$$

The determination coefficient is equal to 0.95.

Regression equations are significant, because the probability that the calculated F-statistic value will fall into the area of hypothesis acceptance is below the significance level ($\alpha = 0.05$). Testing of the significance of all the regression coefficients of the model by the t-criterion shows that they are statistically significant, since probabilities that the *t*-Statistic calculated values fall into the hypothesis acceptance area are below the significance level ($\alpha = 0.05$) (by the Student's criterion). (Chernova, 2009; Kharitonov, 2016).

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The Breusch-Godfrey test says there is no autocorrelation in the residuals. The model is homoscedantic according to the White test. Thus, analysis of the quality characteristics of econometric models shows that equations are acceptable.

7. Conclusion

Summing up the econometric study, we can draw the following conclusions:

- indicators characterizing the agricultural sector are influenced by natural, geopolitical, man-made economic and institutional factors which cause their instability;

- main factors affecting progressive development of the agricultural industry of the Chechen Republic and growth of agricultural production were identified;

- the analysis shows that these parameters form a network with elements influencing each other. This makes it possible to characterize the system as extremely susceptible to internal and external changes;

- at the final stage, stabilization of the positive dynamics of the main parameters of the Chechen agriculture was observed. Linear dependence was predominant.

References

Avtorkhanov, A. I. (2007). *Restoration and development of agroindustrial production of the Chechen Republic*. Moscow: Kontek LLC.

Statistical compilation by the Ministry of Agriculture (2017). *Agro-industrial complex of Russia in 2016*. Moscow: Minagro.

Basovskiy, L. E. (2004). *Forecasting and planning in market conditions*. Moscow: Infra 4.

Chechen statistics (2017). *Chechen Republic in figures.* Grozny: Chechenstat.

Chernova, T. V. (2009). Economic-statistical study of factors affecting agricultural productivity. *Regional economy: theory and practice, 11,* 81-89.

Israilov, M. V. (2013). Forecast scenarios for development of agriculture in the Chechen Republic. *Problems of development of the agro-industrial complex of the region*, *3 (15),* 17-26.

Kharitonov, A. E. (2016). *Statistical study of ecological-economic systems of agriculture: thesis of a cand. of economy sciences*. Novosibirsk: NSU.

Kusakina, O. N., Dykan, Yu. A. (2015). Methodology for assessing sustainable rural development. *Fundamental researches*, *5-4*, 31-39.

Melnikov, A. B., Sidorenko, V. V., Snimshchikova, I. V., Mihailushkin, P. V. (2016). Formation of the concept of food security of Russia. *Economics of Agriculture of Russia, 12,* 107-110.

Usenko, L. N. (2010). *Economic analysis and forecast of socio-economic processes in the agricultural sector*. Rostov-on-Don: GNU VNII of the Russian Agricultural Academy.

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