



Assessment Method the Development of Agriculture in the Region

Ivanova Tatiana* and Ivanova Anna

Department of Research Center for Labor Economic, FSBEI HE "Russian University of Economics named after G.V. Plekhanov", Russian Federation

***Corresponding Author:** Ivanova Tatiana, Department of Research Center for Labor Economic, FSBEI HE "Russian University of Economics named after G.V. Plekhanov", Russian Federation.

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Abstract

The article developed a universal method for assessing the pace of agricultural development (on the example of the Chuvash Republic). Its algorithm includes the following actions: 1) index analysis of the main economic indicators related to the functioning of the region's agriculture for 2011-2020; 2) development of a formula for calculating an integral indicator characterizing their changes; 3) determining the pace of development of the industry. Next, the forecast for three scenarios (optimistic, probabilistic and pessimistic) for 2021-2023 is presented, and for the optimistic one, confidence intervals of the predicted values of the integral indicator characterizing the pace of agricultural development are calculated. This technique mathematically supports and economically substantiates the effectiveness of managerial decision-making related to the development of strategies, projects and programs for the development of agriculture in the Chuvash Republic.

Keywords: Chuvash Republic; Agriculture, Forecasting; Assessment Method; Integral Indicator; Development

Introduction

At the beginning of the XXI century, new realities revealed an urgent need for modern technologies for studying economic processes, both in the national economy as a whole and in agriculture, since pre-reform methods are hopelessly outdated. Taking into account the shortcomings of research on this issue, for example, in the articles by S. Albaik [1], Yu. Lu [9], M. Tahamipur [15], the approach for accounting for indicators with different units of measurement is not taken into account. In the works of S. L. Brunton [4], E. G. Bongiorno [2], N. N. Minina [10] - there is no mathematical justification for the analysis of economic processes. And in the articles of D. J. Khrushchev [5], A. Takchella [14], K. D. Brummit [3], M. Tyapkina [16], A. N. Stavtsev [18], if statistical data are available, do not apply mathematical methods of their forecasting.

Analyzing the results of our previous studies on the assessment methodology [7] and forecasting the social infrastructure of agriculture [8], forecasting agricultural production [6], mathematical modeling in forecasting reproductive processes in agriculture [13], as well as having developed a technology for assessing the impact of social-economic factors for the reproduction of human resources

in agriculture [11,12], the author's algorithm for assessing and forecasting the development of agriculture in the region (on the materials of the Chuvashskaya Res-public). In contrast to the cited works, this article proposes to use the mathematical apparatus for the processes under study and, on the basis of the projections obtained, to carry out effective management of agriculture in order to ensure its positive development.

As research methods, the author used: index, calculation of integral indicators, correlation-regression analysis, forecasting with the calculation of confidence intervals.

The article is aimed at developing a methodology for assessing the rates of development of agriculture of the Chuvash Republic in order to obtain a qualitative predictable result in order to ensure the positive development of the industry.

Materials and Methods

At the initial stage, a sample of the most significant economic indicators characterizing the development of agriculture of the

Chuvash Republic, which is the object of this study, is formed. In its original form, the sample consisted of twelve parameters, but on the basis of correlation analysis, five indicators were identified

that have a significant impact on the development of the industry (Table 1 - compiled according to the Federal State Statistics Service [17]). The selected factors are reduced to an index value (Table 2).

Indicators	Year									
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Balanced financial result (Profit minus loss) organizations agricultural, million rubles	716,0	934,0	790,0	596,0	702,6	694,5	773,1	744,8	176,5	564,3
Production agricultural products, million rubles, including:	15453,1	16768,3	15933,7	17390,5	19155,5	19968,7	21269,3	20187,5	21824,7	21907,4
- animal husbandry;										
- crop production	16669,1	15857,0	14928,6	19663,8	20191,7	19369,6	17467,6	17183,4	18375,5	22929,7
Investments in fixed assets of agriculture (excluding forestry), million rubles	2434,9	3423,2	2713,6	2419,7	2696,0	2230,7	1535,0	1137,2	1634,3	1214,1
Financial investments of organizations in agriculture, million rubles	326,6	377,1	456,6	573,5	359,7	511,9	664,0	818,6	1645,0	1286,1

Table 1: Resource requirements by component, the main economic indicators characterizing the development of agriculture of the Chuvash Republic in 2011-2020.

Source: Rosstat.

The method of index analysis allows you to aggregate a wide range of quantitative evaluation indicators that have different units of measurement and are not compared with each other without standardizing the values. On the basis of Table 1, Table 2 is formed, reflecting the index values of economic indicators characterizing the pace of agricultural development of the Chuvash Republic in 2011-2020 years.

Based on the information of Table 2 according to formula 1 (author's development), an integral indicator characterizing the pace of development of agriculture of the Chuvash Republic in 2011-2020 is calculated, $(II_{P.A.D.})$, in %

$$II_{P.A.D.} = \sqrt[5]{I_{BFR} * I_{LP} * I_{CP} * I_{IFC} * I_{FIO}} \quad \text{-----(1)}$$

где I_{BFR} - index of changes in the balanced financial result (profit minus loss) of agricultural organizations, %;

I_{LP} - Index of changes in livestock production, %.

I_{CP} - Index of changes in crop production, %.

I_{IFC} - Index of change in investments in fixed capital of agriculture, %.

I_{FIO} - Index of changes in financial investments of organizations in agriculture, %.

The values of the integral indicator characterizing the pace of development of agriculture in the Chuvash Republic in 2011-2020) are entered in Table 2. It shows that during the analyzed period, progress in the development of the industry was observed in 2011, 2012, 2014, 2016 and 2020, respectively, when the values of the integral indicator exceeded 100%. At the same time, the maximum jump occurred in 2011, when the rate of agricultural development was 120.1%. This was due to: the signing of the Decree of the President of the Russian Federation dated 30.01.2010 No. 120 "On the Doctrine of Food Security of the Russian Federation", the Decree of the Government of the Russian Federation dated 30.11.2010 No. 2136-r "On the Concept of Sustainable Development of Rural Areas of the Russian Federation for the Period up to 2020", the Order of the Government of the Russian Federation dated 08.12.2011 No. 2227-r "On the Strategy for Innovative Development of Russia until 2020"; the implementation of the National Project "Development of the Agro-Industrial Complex" and the Departmental Target Program "Development of Poultry Farming" <http://old.mcx.ru/navigation/docfeeder/show/181.htm> of the Chuvash Republic for 2010-2015", etc. The remaining years of the study period are characterized by regression.

Indicators	Year										Medium tempo
	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
Index balanced financial result (Profit minus loss) organizations of agriculture	367,2	130,4	84,6	75,4	117,9	98,8	111,3	96,3	23,7	319,7	142,5
Production index productions, including:- animal husbandry;	105,7	108,5	95,0	109,1	110,1	104,2	106,5	94,9	108,1	100,4	104,3
- crop production	246,3	95,1	94,1	131,7	102,9	95,9	90,2	98,4	106,9	124,8	118,6
Change index investments in fixed assets of agriculture (excluding forestry)	150,9	140,9	79,3	89,2	111,4	82,7	68,8	74,1	143,7	74,3	101,5
Change index financial investments of organizations in agriculture	172,9	115,5	121,1	125,6	62,7	142,3	129,7	123,3	200,9	78,2	127,2
Integral indicator characterizing the pace of agricultural development	120,1	117,0	93,8	104,0	98,6	103,1	99,1	96,1	95,4	118,4	104,6

Table 2: Resource requirements by component, dynamics of changes in economic indicators characterizing the pace development of agriculture of the Chuvash Republic in 2011-2020, in % to the previous year.

Source: Author’s development.

If we analyze the average aggregate value of the changes in the indices for 2011-2020, they are located in the following sequence (in descending order): the net financial result - 142.5%; financial investments of organizations in agriculture - 127.2%; production of crop products - 118.6% and livestock production - 104.3%; investments in fixed assets - 101.5%. Consequently, the balanced financial result and financial investments of organizations had the greatest impact on the integral indicator characterizing the pace of development of agriculture in the Chuvash Republic.

Results and Discussion

At the next stage, in order to further detail the problem under study, it is proposed to forecast the integral indicator of the rate of development of agriculture in the Chuvash Republic. Based on its dynamics for 2011–2020 and using the Excel program, Table 3 displays equations for three scenarios for the development of the situation for 2021–2023 (optimistic, probabilistic and pessimistic).

Forecast option	Equation	Year				2023 to 2020, %
		2020	2021	2022	2023	
Optimistic	$y = 0.426x^2 - 6.1318x + 121.48$	118,4	109,3	108,0	107,2	90,5
Probabilistic	$y = 114.42x - 0.062$		99,1	98,1	97,1	82,0
Pessimistic	$y = 115.78x - 0.074$		95,5	94,7	93,4	78,9

Table 3: Resource requirements by component forecast of changes in the integral indicator, characterizing the pace of development of agriculture of the Chuvash Republic until 2023.

Source: Author’s development.

Next, the confidence intervals of the predicted values of the integral indicator characterizing the pace of agricultural development for 20-2023 are calculated for the optimistic forecast (since for it the coefficient of determination showed the highest value), which cover the following ranges

$$94,4107 \leq \leq 114,7079; 95,2582 \leq \leq 114,7236. \\ 97,4764 \leq \leq 113,0069; 98,0621 \leq \leq 112,7225.$$

As can be seen from them for 2020 with a value of 104.6%, is included in the confidence interval for 2020. A similar procedure was carried out by us earlier for 2019, before the actual statistical data for 2020 appeared in the consolidated access. for 2019 was 95.4%, which was also within the predicted range: $94.5684 \leq \leq 104.3736$.

For clarity, figure 1 shows a graph of an optimistic forecast of changes in the integral indicator characterizing the pace of development of agriculture in the Chuvash Republic until 2023.

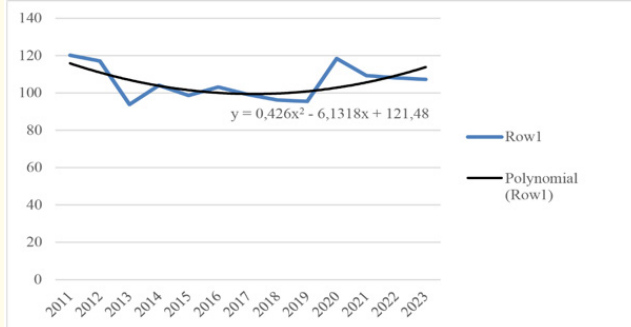


Figure 1: Optimistic forecast of changes in the integral indicator characterizing the pace of development of agriculture in the Chuvash Republic until 2023.

Source: Author's development.

Computer technologies and mathematical methods used at the modern level of knowledge contribute to the calculation of accurate and high-quality forecasts. In accordance with the proposed assessment methodology, it is possible to compare the projected values in the future period, which was repeatedly done by the author and reflected in publications [6-8,11-13].

The obtained range of the confidence interval by 2021 is less than the range of indicators of 2020, which indicates the high efficiency of the measures implemented within the framework of the state program "Economic Development and Innovative Economy", the "Priority National Project "Development of the Agro-Industrial Complex", the federal "State Program for the Development of Agriculture and Regulation" markets of agricultural products, raw materials and food for 2013-2020", the state program of the Chuvash Republic "Integrated development of rural areas of the Chuvash Republic", approved by the Resolution of the Cabinet of Ministers of the Chuvash Republic of 26.12. 2019 No. 606 (as amended on 25.03. 2020 No. 115).

Conclusion

Thus, the developed algorithm is a unique tool for determining the pace of development of agriculture in the Chuvash Republic. This is a multifunctional and reliable short- and medium-term forecasting tool with significant potential. Its use allows not only to assess the impact of economic indicators on the development process, but also social, innovative, legal and others, to ensure the

sustainable development of the country, federal districts and regions. The proposed research technology allows legislative and executive authorities to convincingly justify the need for adopted socio-economic projects and programs.

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