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Multifactor analysis of agricultural production processes and its econometric modelling

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Abstract: *It is important to note that agriculture is a strategically important sector of the economy, which ensures the food security of the country as a whole. It should also be specially noted that the analysis of the ongoing processes of agricultural production, especially the econometric modeling of these processes, will give us a clear picture of the dynamics of the development of the agricultural sector. This article is the result of research in the field of multivariate analysis of agricultural processes and their modeling.*

Key Words: *agricultural sector , multifactor analysis, econometric modelling, matrix, economic availability, econometric assessment, approximation algorithm, purchase quality.*

1. INTRODUCTION:

The agricultural sector plays an important role in ensuring food security in the world, and to some extent meets the material needs and requirements of the population for agricultural products included in the consumer basket. The Food and Agriculture Organization of the United Nations also states that ".. more than 840 million people in the world today do not have access to food. That means almost one in eight of the world's population. In addition, more than 30 percent of the world's population suffers from malnutrition and a lack of essential micronutrients and vitamins. " All this shows that the production of quality agricultural products that are part of the quality of consumption is a topical issue. According to the World Health Organization,

In the context of globalization, the development of infrastructure for the production of agricultural products in the consumer basket, a number of scientific studies on the provision of all segments of the population with basic agricultural products, including the creation of indicators and criteria for assessing the level of agricultural production; Extensive research is being conducted on multivariate statistical analysis and econometric modeling of volume and quality. At present, one of the priorities in the world practice is the statistical analysis of the processes of cultivation of agricultural products in the consumer basket, econometric assessment of the factors influencing it and the development of forecasts.

1.1. LITERATURE REVIEW:

The issues of assessing the socio-economic development and prospects of the agricultural sector have been studied by many foreign scholars. Scientists from the Commonwealth of Independent States E.N. Antamoshkina, T.V. Uskova, R.Ya. Selimenkov, A.N. Anishchenko, A.N. Chekavinsky, P.V. Leshchilovsky, V.G. Gusakov, E.I. .Kiveysha, A.I.Popov, V.S.Balabanov, E.N.Borisenko, I.Ushachev, A.S.Voronov, T.I.Mirzaeva, T.K.Kastuev4 and others in their scientific work in the field of agriculture who paid particular attention to developmental problems.

2. MATERIALS:

Y. Gao et al. present a branch and bound reduced algorithm for quadratic programming problems with quadratic constraints. The algorithm determines the lower bound of the optimal value of original problem by constructing a linear relaxation programming problem. To improve the degree of approximation and the convergence rate of acceleration, a rectangular reduction strategy is also used in the algorithm.

Y. C. Zhang et al. propose an improved self-adaptive particle swarm optimization (IDPSO) algorithm with detection function to solve multimodal function optimization problems. The evolution direction of each particle is redirected dynamically by tuning the three parameters of IDPSO in the evolution process to overcome the premature convergence of PSO in a short time. Numerical results on several benchmark functions indicate that the IDPSO strategy outperforms other variants of PSO.

"A review of piecewise linearization methods" by M.-H. Lin et al. introduces recent advances in piecewise linearization methods and analyzes the computational efficiency of various piecewise linearization methods.

"Sensitivity analysis of the proximal-based parallel decomposition methods" by F. Ma et al. shows that the range of the involved parameters can be enlarged, while the convergence can be still established.

X. Wang studies a new class of optimization problems and develops a strong duality theory for stochastic separated continuous conic programming. A polynomial-time approximation algorithm is also presented to solve the stochastic separated continuous conic programming problem with any predefined accuracy.

3. METHOD:

In the process of preparing the research, such methods as methods such as scientific observation, comparative analysis, analysis and synthesis, economic-statistical analysis, econometric modeling, forecasting were used in the research process.

4. DISCUSSION:

In order to further increase the openness of the Uzbek economy, the issues of identifying threats to economic security and developing mechanisms to eliminate them remain relevant. Safety is of particular importance in the food aspect. This is, first of all, a basic vital necessity for the population to consume food, because the creation of conditions for the delivery of its quality in reasonable quantities and at affordable prices is one of the priorities of all levels of government.

Ensuring food security requires the development of reliable forecasts for the development of agricultural production. It is based on economic-statistical models that describe the statistical dependence of the studied economic indicator and is determined by the main factors influencing it.

The technology of expanding the scope of statistical modeling, especially in connection with the rapid development of multiple computing systems, allows to simulate many independent statistical experiments. On the other hand, classical computational methods for studying complex mathematical models of the phenomena under study are often unsatisfactory. This, in turn, enhances the role of economic-statistical modeling, which has little to do with the dimensions and geometric details of the problem. The analysis shows that the tools currently used in the practice of state and municipal administration do not give a completely acceptable level in the provision of agricultural products to the population in Surkhandarya region.

More than half of the demand for some food products is met by imported products. Consequently, measures to promote competition in the domestic market, regulate customs and tariffs, and stimulate growth in agricultural production do not always reduce the risk of food shortages as a result of declining imports The economic availability of agricultural products remains generally low. This is mainly due to the fact that the population has higher price growth rates than real money income growth rates, which leads to a decrease in their purchasing power. Therefore, state and local authorities need to address the issue of expanding the opportunities for citizens to purchase quality agricultural products in the near future. There are other problems in providing the country's population with agricultural products, which requires all levels of government to develop the necessary and timely roadmap.

However, another pressing problem in agricultural production at the regional level is the lack of perfect mathematical models for assessing and forecasting its condition, which requires taking into account the factors of supply and demand in the regional food market.

On the basis of scientific research it will be possible to determine a set of conditions that provide the population of Surkhandarya region with agricultural products at the regional level. Because they allow the system of production, storage, processing, wholesale and retail trade of agricultural products to meet the needs of all social groups of the population in a stable and uniform throughout the year with scientifically based quality, medical standards. At the same time, it is important that economic entities engaged in the production and sale of agricultural products should work in an expanded reproductive mode. We know that the most important requirement for the provision of agricultural products to the population in the regions is the sufficiency of basic agricultural products. In our opinion, this level is achieved through the cultivation of basic types of agricultural products in the regions in quantities that meet rational standards. Thus, using the values of the above indicators, it is possible to forecast the production of agricultural products in the region, to determine the reserves for its increase. The natural conditions of Tashkent region are characterized by arid climatic conditions, which do not provide sufficient moisture for the cultivation of agricultural products. In the process of correlation-regression analysis of official statistical reports for Surkhandarya region in 2009-2017, the impact of various factors on the dynamics of food production was identified.

5. ANALYSIS:

The main indicators of agricultural production and agricultural activity in Taskent region dynamics

Table 1

Years	Potatoes (tons)	Vegetables (tons)	Melons (tons)	Wet fruit (tons)	Grapes (tons)	Farms growing agricultural products number (pieces)	Number of techniques used to grow the product (pieces)	**Sown area size (ha)**	Number of workers involved in agriculture (people)
2009	116509	429567	102872	84123	67471	4652	9194	771022,694	140301
2010	127550	486419	113947	92292	77051	4850	9194	771022,694	135500
2011	145100	540157	123562	101542	95141	5028	9194	771022,694	145669
2012	159042	632884	137346	108763	103196	5140	9413	774999,496	111791
2013	174879	689835	150042	119085	113029	5155	9413	774999,496	149944
2014	193997	807007	169934	124806	115695	5323	9413	774999,496	140444
2015	217802	869498	197397	137782	118801	6003	9413	774999,496	129863
2016	244826	966804	207923	154457	135518	8833	9413	780999,496	131380
2017	279743	983953	231774	154951	135890	10302	9413	794999,496	130300

According to him, in modeling the dynamics of key indicators of agricultural production in the region - such as the volume of potatoes (Y1), vegetables (Y2), melons (Y3), grapes (Y4), wet fruits (Y5) indicators such as the number of machines used to grow the crop (X1), the number of farms (X2), the size of the crop area (X3), and the number of workers (X4) were selected as factors influencing these indicators.

In doing so, we consider measuring the coherence of the relationship between factors, determining the causes of factor dependence, constructing a regression model, and evaluating the parameters. We use multivariate regression in the study of dependence by multifactor correlation-regression methods.

$$y = f(x_1, x_2, x_3, x_4)$$

Using the data of the Tashkent Regional Department of Statistics for 2009-2017, we consider a matrix of double coefficients of correlation between the main types of agricultural production in the region and the main indicators of agricultural activity.

Matrix of double coefficients of correlation between the main indicators of potato production and agricultural activity in Tashkent region.

Table 2

	Y_1	X_1	X_2	X_3	X_4
Y_1	1	0,906	0,747	0,876	-0,234
X_1	0,906	1	0,484	0,939	-0,250
X_2	0,747	0,484	1	0,547	-0,367
X_3	0,876	0,939	0,547	1	-0,267
X_4	-0,234	-0,250	-0,367	-0,267	1

Matrix of double coefficients of correlation between the main indicators of vegetable production and agricultural activity in Tashkent region. Melon cultivation and agriculture in Tashkent region between the main indicators of economic activity matrix of even coefficients of correlation.

Table 3

	Y_3	X_1	X_2	X_3	X_4
Y_3	1	0,871	0,764	0,834	-0,245
X_1	0,871	1	0,939	0,939	-0,250
X_2	0,764	0,484	1	0,547	-0,367
X_3	0,834	0,939	0,547	1	-0,267
X_4	-0,245	-0,250	-0,367	-0,267	1

Grape growing and agriculture in Tashkent region matrix of double coefficients of correlation between the main indicators of activity

Table 4

	Y_4	X_1	X_2	X_3	X_4
Y_4	1	0,776	0,851	0,744	-0,200
X_1	0,776	1	0,484	0,939	-0,250
X_2	0,851	0,484	1	0,547	-0,367
X_3	0,744	0,939	0,547	1	-0,267
X_4	-0,200	-0,250	-0,367	-0,267	1

Matrix of double coefficients of correlation between the main indicators of wet fruit growing and agricultural activity in Tashkent region

Table 5

	Y_5	X_1	X_2	X_3	X_4
Y_5	1	0,856	0,791	0,792	-0,221
X_1	0,856	1	0,484	0,939	-0,250
X_2	0,791	0,484	1	0,547	-0,367
X_3	0,792	0,939	0,547	1	-0,267
X_4	-0,221	-0,250	-0,367	-0,267	1

6. RESULT:

Analyzing the obtained matrices, it can be concluded that U1, U2, U3, U4, U5, factor and X1, X2, X3 are high with factors (double correlation coefficients, respectively, 0.906, 0.747, 0.876 for potatoes; 0.821, 0.824 for vegetables; 0.772; melon crop for 0.871, 0.764, 0.834; 0.776, 0.851, 0.744 for grapes; 0.856, 0.791, 0.792 for wet fruit), but the value of the double correlation coefficient with factor X4 is very low (correlation coefficients, respectively -0.234 for potatoes, -0.24 for vegetables, -0.245 for melons, -0 for grapes) , 2, -0,221 for wet fruit). It is therefore not advisable to include this factor in the equation. The double correlation coefficient between factors X1 and X3 is high (correspondingly correlation coefficients 0.939), which indicates the presence of multicollenity between them. Therefore, we include only one of the factors X1 and X3 in the equation. The analysis was performed using the EXCEL software tool. The calculation results are given in Table 6.

Table 6

Indicator	*Potatoes*	*Vegetables*	*Melons*	*Grapes*	*Wet fruit*
R plural	*0,9725*	*0,9548*	*0,9550*	*0,9480*	*0,9588*
R – square	*0,9459*	*0,9117*	*0,9120*	*0,8987*	*0,9193*

Normalized R - square	*0,9278*	*0,8823*	*0,8827*	*0,8650*	*0,8924*
Default error	*14729,8*	*70688,87*	*15443,34*	*8726,56*	*8416,03*
F	*52,4661*	*30,986*	*31,103*	*26,634*	*34,2041*
Coefficient (Y_1)	*-1818346,6*	*-9422268,8*	*-1650913,6*	*-1186329,8*	*-1006798,5*
Coefficient (X_1)	*19,4073*	*56,4987*	*14,6759*	*5,6195*	*7,8879*
Coefficient (X_2)	*201,660*	*1047,85*	*184,173*	*134,76*	*115,42*
Default error(Y_1)	*499317,95*	*2396244,6*	*523505,6*	*295817,27*	*285290,71*
Default error(X_1)	*2,9610*	*14,2101*	*3,1044*	*1,7542*	*1,6918*
Default error(X_2)	*54,3744*	*260,944*	*57,008*	*32,2137*	*31,0674*
t-statistics (Y_1)	*3,6416*	*3,9320*	*3,15357*	*4,0103*	*3,5290*
t-statistics (X_1)	*6,5542*	*3,9759*	*4,72732*	*3,2033*	*4,6623*
t-statistics (X_2)	*3,7087*	*4,01563*	*3,23064*	*4,1833*	*3,7154*
Tracking	*9*	*9*	*9*	*9*	*9*

Based on the data in Table 6, the R correlation multiplicity coefficient is 0.97 in potato production, 0.94 in grape production, and 0.95 in vegetable, melon, and wet fruit products, indicating a gypsum correlation between the factors. The R2 determination coefficient shows that 94% in potato production, 89% in grape production, and about 91% in vegetable, melon and wet fruit products are conditioned by the factors included in the model. We continue the analysis by examining the significance of regression based on Fisher's F-criterion. The value of the F-criterion in the table is 5.41 with a reliability probability of 0.95. This is because the Fhisob> Fjadval inequality for potatoes, vegetables, melons, grapes, and wet fruit products in Table 6 is reasonable, so the regression equation can be considered valid. Hence, the regression equation according to Fisher's F-criterion is significant. The results of the evaluation of the significance of the regression coefficients by the Student's t criterion showed the significance of all the coefficients. The results of the calculations confirm that the greatest impact on achieving the optimal level of this coefficient is related to factors such as crop area, number of farms and availability of machinery.

Analysis of the obtained regression equations shows that the factor X2 (number of techniques) has the greatest impact on the volume of production in absolute growth: increase in the number of techniques by 1%, potatoes, melons, fresh fruits by 10%, vegetables by 13% , while grape production increased by 11%. The 1% increase in the number of farms will increase the production of potatoes by 0.6%, grapes by 0.3%, fresh fruits by 0.2%, and vegetables and melons by 0.5%. After replacing the approximate values of the parameters of the factors in the obtained regression equations, the factors of consumption sufficiency and the coefficients of economic availability of food were determined. Calculations allow us to conclude that in the future, according to physiological norms, potato production per capita will be 55%, vegetables 100%, melons 3 times, grapes 2.3 times, and wet fruits 23% lower. . In the future, the economic supply of food will increase as the income of the population increases significantly. From the results of the calculations, it can be concluded that the regional, district and city authorities should give priority to increasing economic opportunities for the cultivation of agricultural products in Tashkent region. It is necessary to support the export of agricultural products grown at a higher level than the physiological norm, and to provide agriculture with modern equipment on the basis of the observed income. Undoubtedly, stimulating the development of agricultural production, its transition to the path of rapid development is a necessary condition for providing the population of the region with food in the consumer basket. Thus, when all governments and enterprises take comprehensive measures to provide the population with agricultural products, it is possible to achieve a sufficient level of consumption and economic availability of food products.

7. FINDINGS:

- If we pay attention to the indicators of agricultural production in Tashkent region to provide the population with agricultural products, it is found that there is a growth trend in the production of these products, but there is no stability in the growth trend. One of the main reasons for this is that the practice of applying advanced foreign experience, which allows to increase the number of modern agricultural machinery and productivity in the region, is not provided in all districts and cities of the region. In our opinion, the production of agricultural products on the basis of technical and technological equipment of agriculture in the region will ensure growth in terms of food security of the regions.
- The growth of agricultural production in the region is high, and in 2009-2018 the growth rate was 2.4 times for potatoes, 2.3 times for vegetables, 2.25 times for melons, 1.84 times for wet fruits and 2 times for grapes.

equal to. Also, the change in productivity for these products is insignificant, the growth of production has been achieved due to the expansion (extensive) of arable land in the region.

- Analysis of the obtained regression equations shows that the largest impact on the volume of agricultural production in the region is the number of agricultural machinery and farms: increase in the number of agricultural machinery by 1%, potatoes, melons, wet fruit production by 10% , a 13% increase in vegetable production and an 11% increase in grape production. The 1% increase in the number of farms will increase the production of potatoes by 0.6%, grapes by 0.3%, fresh fruits by 0.2%, and vegetables and melons by 0.5%.
- According to the forecast, in 2023, the production of wheat in Tashkent will increase by 2% compared to 2018, potatoes by 62%, vegetables by 25%, melons by 72%, fresh fruits by 35%, and grapes by 35%. It can be reduced by 52%.

8. RECOMMENDATIONS:

In order to effectively and reliably provide the population of the region with agricultural products included in the consumer basket on the basis of research and study of foreign experience, it is necessary to pay attention to the following by constantly monitoring the condition of arable land in the region to go storage of agricultural products in the region, processing; increase the number of enterprises with modern technologies that allow processing and packaging; Establish efficient and economical use of water resources through the use of modern technologies in irrigation and further increase the responsibility of water users, depending on the climate of the region;

training of the population and farmers in the use of effective modern methods of crop protection against various pests and diseases in the cultivation of agricultural products;
to provide the region with quality seed materials and seedlings suitable for the climate of the region, taking into account the hot climatic conditions; increase the number of warehouses with the capacity to store large quantities of agricultural products in the region. Through them, each year to maintain the main types of fruit and vegetable products, keep prices in domestic markets stable and use these products for the needs of the population in the autumn-winter season. In Tashkent region, all authorities and enterprises should take comprehensive measures to provide the population with agricultural products and strive to ensure adequate consumption and economic sustainability of food products.

It is proposed to use adaptive methods in the short-term forecasting of agricultural productivity in the detection of random deviations specific to the arid zone due to the hot climatic conditions of Tashkent region. In order to further increase the productivity of agricultural products in the region, it is necessary to restore the productive forces of agricultural land, to implement reclamation measures, the use of mineral fertilizers and various additives.
Production of agricultural products in Tashkent region If we look at the indicators, it was found that there is a growth trend, but there is no stability in the growth trend. One of the main reasons for this is the lack of consistency in the application of advanced foreign experience, which allows to increase the number of modern agricultural machinery and productivity in the region in all districts and cities of the region. In our opinion, on the basis of modern equipment and technological equipment of agriculture in the region will be achieved growth in agricultural production and food security in the regions.

9. CONCLUSION:

As a result of research and studies conducted in the framework of this research, the following conclusions and recommendations were developed:

- In assessing the level of provision of the population with agricultural products in the consumer basket in the regions, to determine the factors that determine it, as well as to determine the factors influencing its development, the application of the criteria for assessing the level of agricultural products in the consumer basket. The dissertation assesses the level of provision of the population in the consumer basket in the regions by adding the Ginnie coefficient of income concentration in determining the indicators of the assessment of the level of provision of agricultural products in the consumer basket in the regions a system of indicators has been developed.
- The indicators of the dynamics of agricultural production in the consumer basket in Tashkent region for 2009-2018 were analyzed comprehensively using economic and statistical models, and forecast values were determined. The results of the analysis show that in 2023, the region can produce 622169 tons of wheat, 473184 tons of potatoes, 1252228 tons of vegetables, 415846 tons of melons, 48892 tons of grapes and 202721 tons of fresh fruits. It is advisable to take these results into account in the development of marketing strategies for the export of agricultural products in the region.
- The cultivation of agricultural products included in the consumer basket in the regions is one of the main directions in ensuring food security. The analysis of regression equations shows that the largest factor in the

volume of agricultural production in the region is the number of machines: increase in the number of machines by 1%, potatoes, melons, wet fruits by 10%, vegetables by 13%, grapes by 13%. while an increase of 11%. It was found that a 1% increase in the number of farms will increase the production of potatoes by 0.6%, grapes by 0.3%, fresh fruits by 0.2%, and vegetables and melons by 0.5%. Therefore, it was proposed to increase the number of farms in the region, to develop mechanisms to increase the number of modern equipment for agricultural production.

- In the regions, proposals have been developed to improve the mechanisms for the systematic implementation of interrelated and coordinated organizational, economic, legislative, administrative and social measures at the lower and upper levels of regional governance in the provision of agricultural products to the consumer basket. This was based on the need to improve governance at the regional and national levels on the basis of adapting the means of determining the internal reserves of industry to the rapidly changing conditions of economic governance.
- The study developed a model for the effective organization of agricultural production per capita in accordance with physiological norms in the regions. The proposed model also proposes measures to provide agriculture in Tashkent region with modern equipment on the basis of income, supporting the export of agricultural products grown at a higher level than the physiological norm to provide the population with agricultural products in the consumer basket.

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