

ECONOMIC-MATHEMATICAL MODELING OF OPTIMAL LEVEL COSTS IN THE GREENHOUSE VEGETABLES

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ABSTRACT

Annotation In the work based on the actual data for 2013-2017 the dynamics of average consumer prices for vegetable greenhouse products in the Republic of Uzbekistan is studied. An econometric model of pricing has been constructed, taking into account the factor of seasonality and its applicability is shown for forecasting the price of vegetable products for subsequent periods.

KEYWORDS: economic-mathematical modeling, vegetable greenhouse products, pricing, moving average, seasonal indices, additive model, greenhouse vegetables

1. INTRODUCTION

Agriculture plays an important role in the Uzbekistan economy, providing 37% of GDP and about 55% of employment. According to the Ministry of Agriculture of the Republic of Uzbekistan, about 600,000 tons of vegetables or 4 kg per capita per year are currently produced in the agricultural production of protected soil. To ensure, according to the medical norm (15 kg per person per year), the country's agrarians need to produce annually about 1.7 million tons. To increase the production of greenhouse vegetables and increase the competitiveness of greenhouse vegetable production, within the framework of the State Program for 2016-2020, a partial (up to 20%) cost recovery for energy resources is envisaged, which will ensure an increase in the profitability of vegetable production of the closed soil. At the same time the gross harvest of vegetables in 2018 should reach 720 thousand tons, and in 2020 - 1720 thousand tons [5]. In recent years, the volume of agricultural production has increased more than twofold. This allowed to increase per capita consumption of meat by 1.3 times, milk - more than 2 times, fruits - almost 4 times. Scientific works of scientists are devoted to scientific research of theoretical and methodological aspects of the problem of sustainable development of agriculture and the market of vegetable growing of protected soil. Zuev, U. Umurzakov, A. Kadirov, V.P.Zvolinsky, M. Lee, A.S. Ermakova, L.P. Silayeva and others. Object. The purpose of the study is to substantiate the theoretical and methodological provisions and develop practical recommendations for improving the organizational and economic mechanism for the development of greenhouse organizations.

2. MATERIALS AND METHODS

Analysts estimate the export potential of the agrarian sector of Uzbekistan in more than 5 billion US dollars. The Republic is gradually becoming one of the major exporters of high-quality and competitive fruit and vegetable products. But in general, the grain problem has not been solved so far, the country buys more than one million tons of food grain in Kazakhstan alone. The climate of Uzbekistan favors the development of agriculture. The abundance of solar heat and light, mild short winters, fertile irrigated soils, extensive pastures allow growing cotton and other valuable heat-loving crops here, obtaining high and stable grain yields, and breeding cattle. Agriculture of the republic is characterized by high intensity. This allows the most rational and full use of a variety of natural conditions. The structure and nature of agriculture can be divided into three main climatic subzones. According to the International Center for Trade and Sustainable Development (ICTSD) research, since 2016, agricultural production in Uzbekistan

has been growing at a fairly rapid pace. The coefficient of average growth rate of gross agricultural output in 2006-2017. was 2.4% per year [3]. The increase in production was noted both among domestic producers and importers of agricultural products. The national consumer, taking into account the comparative advantages and competitiveness of domestic products, aspires to purchase the products of domestic commodity producers.

In accordance with the third priority direction of the Strategy for the Development of the Republic of Uzbekistan, the country is carrying out cardinal reforms to liberalize foreign exchange regulation, foreign trade regime, customs and tax legislation, which creates the most favorable conditions for the resumption of Uzbekistan's accession to the WTO. Within the framework of elaborating the issues of Uzbekistan's accession to the WTO and attracting technical assistance, the Ministry of Foreign Trade of the Republic of Uzbekistan with the support of the United Nations Development Program organized a working meeting with representatives of international organizations such as the Asian Development Bank (ADB), the World Bank, the United States Agency for International Development), The Delegation of the European Union in Uzbekistan, the German Society for International Cooperation (GIZ) and others.

In order to ensure effective systemic work and regular monitoring of the process of Uzbekistan's accession to the WTO, the Cabinet of Ministers approved a "road map", which includes 34 activities aimed at preparing documentation to resume the process of accession and adaptation of national legislation. Some conditions for the accession of our country to the WTO were the reduction of the import customs duties, the restriction of the dominance of a number of industries and agriculture, which may lead to an increase in the competitiveness of foreign goods [6].

As a result of fulfilling the obligations to the WTO, which envisage lowering the rates of import duties on a wide range of agricultural products, increase in prices for mineral fertilizers, the abolition of VAT exemptions applied to some types of domestic agricultural products; resetting ex of agricultural subsidies, it can be. Farmers will account for more than one-third of the short-lived growth [5]. In the current situation, the price of domestic agricultural pro is one of the key tools for the successful development of domestic agricultural producers and the entire agricultural whole. The cost-based approach to pricing is the most traditional in terms of transition period. He focuses pricing mainly on the internal production factors of development of economic activity and semi the predetermined rate of return on products. However, this approach Does not take into account the consumer demand for products and the presence of a huge army producers-competitors, which appeared when Russia joined the WTO. Ana prices for the sale of agricultural products must inevitably accompany to study the dynamics of prices for the corresponding goods.

In the present work, the dynamics of prices for greenhouse vegetable agricultural-economic products in the Uzbekistan for the last five years from 2015 to.2017 In addition, an attempt is made to forecast the prices of agricultural-economic output for subsequent years [5, 6]. At the initial stage, the dynamics of prices for vegetable as a whole. For the sake of clarity, a number of chain price indices was converted to a number of basic indices. In Figure 1 a numerical series of the moving average of the price, as well as its linear trend.

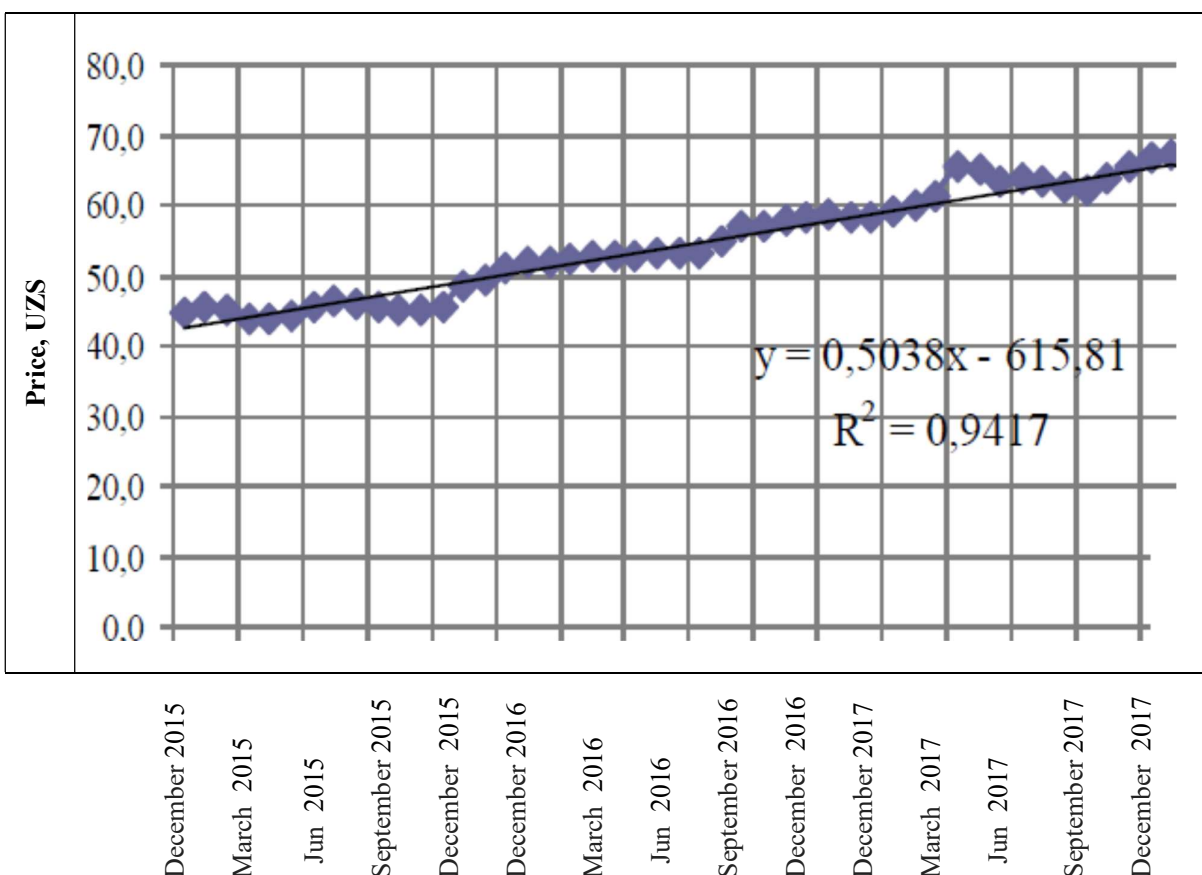


Figure 01: Dynamics of prices for cucumber greenhouse by the value of the moving average

Over the past five years, the price of a greenhouse cucumber has grown about 1.5 times, and the income of the population - 1.7 times. In accordance with observations in 2006 and the required consumption of vegetable products recommended by the Ministry of Health of Uzbekistan, there is a clear tendency to reduce the share of income of the population spent for the purchase of agricultural products, in particular, a greenhouse cucumber (Figure 2).

$$Y = -0,0002x^4 + 0,0057x^3 - 0,0626x^2 + 0,2221x + 0,4127 \quad (1)$$

Preliminary analysis allows us to conclude that the given dependence (1) has a clear tendency to decrease, and also that the dependence can be easily approximated by means of a fourth-degree polynomial with a high level of reliability of the result, a determination coefficient R^2 . Visual analysis of the moving average graph (Fig. the conclusion about the presence of not only a completely natural upward trend in the time series, in our opinion, linear, but also quite distinct seasonal price fluctuations.

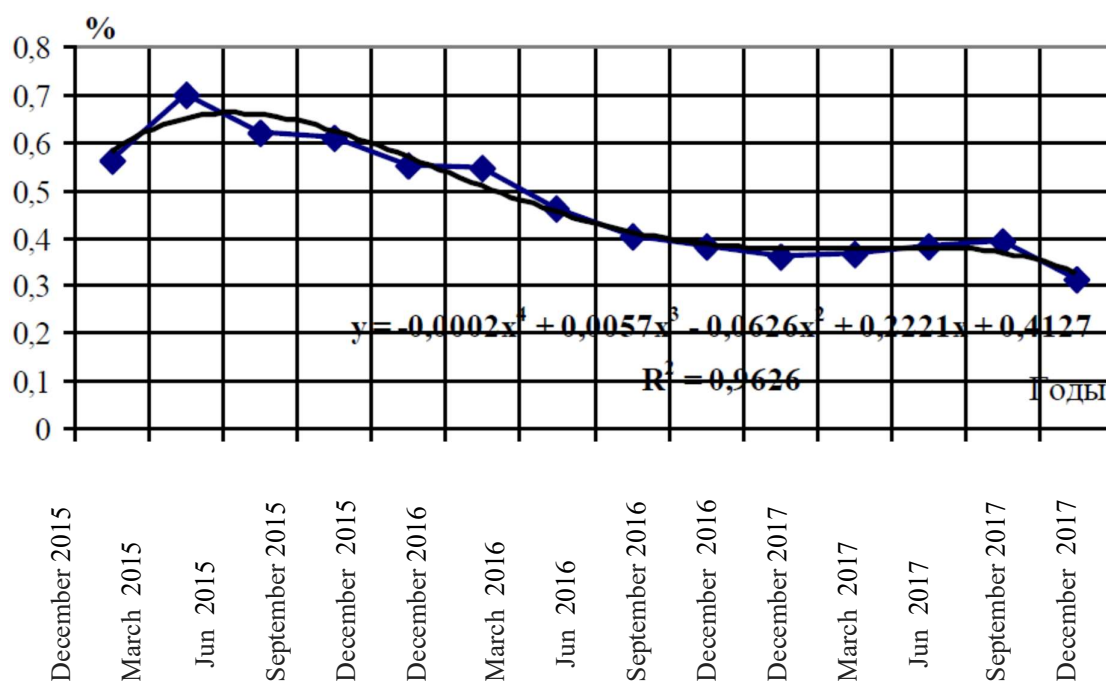


Figure 2 - Average share of a citizen's income Uzbekistan, aimed at the acquisition of vegetable greenhouse products

The determination of trends in price changes over time without taking into account and taking into account seasonality was carried out using the statistical functions of the package Ms Office Excel TENDENCY (), CORREL (), etc. To obtain an idea of how close the trend was without taking into account seasonality to the initial data, a correlation was determined between the values of the trend and the actual reference prices. The correlation value of 0.19 (and the corresponding value of R2, approximately 0.15) indicates that the conventional trend does not describe the behavior of the data very well. This shortcoming was eliminated by including the seasonality factor in the model. The inclusion of seasonal factors and their analysis was carried out in the following stages:

1. For each month, seasonal indices are calculated that characterize influence of seasonality.
2. These indices were used to calculate the desesonalized seasonal adjustment) for each month.
3. Based on desesonalized values, the trend was determined.
4. The actual trend is calculated by adding seasonal indices to calculated at the previous stage of the trend.

Indices were added to the trend when an additive data model was investigated, that is, when the value is the sum of the trend value and the seasonal variation. The presented spreadsheet (Figure 3) made it possible to calculate the relations for each month during the entire history of the data. After that, the average value for each month was calculated in the "Average ratio" column. However, in order to obtain the final values of the seasonal indices, an amendment was made: the sum of the indices should be 1200 (an average of 100 for each month); then they really will represent a percentage difference in the values. Each average value was reduced by 1.0290 times (= 1234.8 / 1200). This amendment was applied in the column "Seasonal index", where the correct values of seasonal indices for each month are contained.

Table 01: Calculation of monthly seasonal indices

№	Months	Average Ratio	seasonal index	Indices 2013	Indices 2014	Indices 2015	Indices 2016	Indices 2017	Indices 2018
1	January	167,5	162,8	131,4	200	209,6	164,8	269,6	162,57
2	February	188,4	183,1	184,1	191,9	212,6	164,8	271,1	170,75
3	March	155,6	151,3	159,7	170,9	151,6	140,4	216,2	139,80
4	April	132,4	128,7	136,9	135,3	141,5	116	186,75	119,41
5	May	106,1	103,1	117,1	107,5	109,7	91,1	145,95	95,23
6	June	63,7	61,9	70,2	63,3	64,7	56,7	89,05	57,33
7	July	54,1	52,6	49,7	56,9	41,3	68,7	89,35	50,99
8	August	48	46,6	47,8	43,5	36,7	63,9	82,25	45,69
9	September	43,6	42,4	35	32,1	44,6	62,8	85,1	43,27
10	October	66,4	64,6	66,3	60,3	72,1	67,1	103,15	61,49
11	November	92,2	89,6	99,6	88,3	102,4	78,5	129,7	83,08
12	December	116,7	113,4	114,5	97,7	157,5	104,4	183,15	109,54
	Total	1234,8	1200						
	Skorr.								

each index = the actual value
for the month / 12 month moving average

The seasonal indices obtained were used to carry out the seasonal or de-desalination of data from which seasonal factors were removed. Using the function MS Office Excel TREND, a trend is defined based on new desesonalized values. To obtain the true value of the trend, the desesonized trend and the seasonal component were summed. A correlation value of 0.93 indicates that the new trend optimally simulates the original data. To obtain forecast values for the value of products, including season-factors, an additive model of the time series of the form $Y = T + S + E$, (2) where T - trend, S - seasonal and E - random components of time series.

For the objectivity of the evaluation, the work combines techniques that, to calculate the usual forecast trend and the rescheduled historical trend. Figure 4 shows a graph that compares the actual value of greenhouse products and the trend, taking into account seasonality, as well as forecast values, taking into account seasonality. Seasonal price increases occur throughout the winter months, and especially at the early spring months. And, on the contrary, the seasonal decline in prices occurs in the summer and early autumn. Amplitude of seasonal price fluctuations in the range from the most "expensive" (February) to the "cheapest" month (September) is very significant - about 100%. The value of the coefficient of determination $R^2 = 0.93$ indicates that the dynamics of prices for greenhouse products in the period 2013-2017. is determined by a linearly increasing trend and additive seasonal fluctuations.

Import supplies of hothouse agricultural products influence on the price level, but the cucumber takes a small share in the import of agricultural products, because this product is more "tender" and does not tolerate long-term storage and transportation. Recently, a program for the development of vegetable growing began in the country closed ground, which provides for growth in vegetable production in greenhouses by 2020, 3.5 times - from today's 500 thousand tons to 1.7 million tons. The area of greenhouses should increase to 4.7 thousand hectares against 1.8 thousand hectares at the present time. 40 billion rubles will be allocated for the implementation of the program. As a result of such measures, Uzbekistan plans to completely abandon the import of greenhouse vegetables by 2020 [5].

The presence in the region of modern greenhouse complexes, their technological opportunities and innovative technologies used are the most significant factors in the pricing of the final product. The geographical location of the greenhouse complexes directly affects the production volumes, profitability and competitiveness of the products. Regular delivery of products to the places of consumption is estimated by certain costs, which occupy a significant share in the costs of production and sales of products. Uzbekistan in the World Trade Organization in connection with the consumer the specific features of the products will not have a noticeable effect on its pricing in the domestic market, but the program for the development of greenhouse vegetable production, the Government's resolutions on the support of domestic producers, will undoubtedly affect the consumer price of the goods.

CONCLUSIONS

The used econometric approach accurately reflects the outcome of the statistical data on the price of cucumber greenhouse and can be used for preliminary forecasting of the average price for vegetable greenhouse products, at least for the nearest calendar period. The calculated correlation coefficient ($k = 0.93$) between the actual data and the simulated trend, taking into account the seasonal and random components, indicates a sufficiently high degree of adequacy. For a more accurate price forecast for greenhouse vegetables, it is necessary to consider the qualitative composition of costly and other external factors for the theoretical construction of the response function. Modeling the pricing of domestic greenhouse products will make it possible, in order to increase the predictability of the demand for greenhouse vegetables, to achieve certain uniformity in their production, sales and the production of a stable profit.

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