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FORECASTING THE DEVELOPMENT OF AGRICULTURAL PRODUCTION IN THE CONTEXT OF FOOD SECURITY

Stepan Petrovich BURLANKOV[1], Mikhail Aleksandrovich ANANIEV[1], Alexandr Alexandrovich GAZHUR[1], Nadezda Vasilievna SEDOVA[1], Olga Mikhailovna ANANIEVA[2]

[1]Plekhanov Russian University of Economics, Moscow, 36 Stremyanny Lane, 117997, Moscow, Russian Federation; Phone: + 7 (499) 237-85-17, Emails: burlankovs@inbox.ru, ananievm@inbox.ru, alexandr.gazhur@bk.ru, nadezda.v.sedova@mail.ru
[2]Mordovian State Pedagogical Institute n. a. M. E. Evseviev, Saransk, 68 Bolshevistskaya Street, 430005, Saransk, Russian Federation; Phone: 89875730070, Email: o.ananieva@list.ru

Corresponding author: burlankovs@inbox.ru

Abstract

The urgency of this study is substantiated by the problems related to forecasting the development of the national food market and the need to increase the capacity of the food security system. The problem becomes especially urgent due to the need to improve its sustainability and competitiveness. That is why in order to solve the problems of developing the national food security system, it is important to understand strategic benchmarks where the forecasts are considered to be especially important substantiated development benchmarks. The reality level of substantiating parameters of the food market development in the forecast models depends on the degree of accounting resources of the food commodity groups, and the opportunities for their forecasting are the basis for the reality of the forecast development scenarios. That is why the approach offered in the article assumes the solution to an urgent and timely problem. The goal of this article is to substantiate methodological approaches to commodity group forecasting of the food market development as the most objective in the system of strategic food security management, and based on this, to substantiate offers on developing the national food security system. Defining strategic long-term forecasts of the national food security system development and parameters of the food market based on them is an important area of scientific studies based on a comprehensive analysis of the agro-food market's activity, identifying the existing problems and developing offers on improving management instruments. The objects of the study are strategically important commodity groups of the production food subsystem of the national economy and food resources of the market.

Key words**:** *agriculture, import substitution, forecasting, food security, grain*

INTRODUCTION

The urgency of this study is substantiated by the problems in the strategy of the further development of the national food security system. Under the existing circumstances, the revealed imperfection is related to the insufficient scientific substantiation of the methodology to forecast the parameters of the production subsystem: the methods used to forecast the parameters of the national food security system development do not fully take into account the peculiarities and resource potential of the production subsystem by food groups. Therefore this problem becomes especially important in the context of the sanctions regime and the growing competition. The need in the objectivity and reality of the forecast models in the strategy of food security management under these conditions seems to be a factor that solves the problems on further increase in the resources of the food market [9].

The need to take into account the principles of predictability in the system of strategic management measures is indicated in Decree of the President of the Russian Federation No. 120 dated 30.01.2010 and the Doctrine of Food Security of the Russian Federation dated November 28, 2008, and are formalized in the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food Markets for 2008-2012. [5, 7].

Legislatively the consistency and predictability principle is applied in measures

on implementing Resolution of the Russian Government No. 717 dated 14.07.2012 "On the State Program for the Development of Agriculture and Regulation of Agricultural Products, Raw Materials and Food Markets for 2013-2020". Besides, this principle is applied in the National security strategy of the Russian Federation until 2020 approved by Decree of the President of the Russian Federation No. 537 dated May 12, 2009. In accordance with the orders of the President of the Russian Federation and the Government of the Russian Federation, measures were initiated to improve the forecasting mechanisms stated in the Concept of Long-Term Socio-Economic Development of the Russian Federation until 2020 (approved by Order of the Government of the Russian Federation No. 1662-r dated November 17, 2008) [4, 14].

Thus, the issues on improving approaches to forecasting in the system of measures on strategic management of the national food security system and food market development are an urgent and timely problem.

Today, long-term trends in prices for agricultural products have strategic consequences for food security. They are as important as the trends related to short-term price leaps for the trend. In their work Raushan Bokusheva, Hockmann Heinrich and Subal Kumbhakar [3] studied the latest generalizing market forecasts for different scenarios, and then analyzed data on how trade policy restrictions are usually changed to prevent national markets from short-term fluctuations in international prices around their long-term trends.

It is known that over the last 50 years the international agricultural trade has been developing rapidly. In particular, in the 1960s, analytical studies were focused on the crisis in the global agriculture caused by the policy of supporting domestic prices. There were attempts to measure the results caused by the national policy in developing countries and to form a model of their impact on the world agricultural markets. T. Josling, K. Anderson, A. Schmitz, and S. Tangerman [10] developed instruments to explain trends and fluctuations in world prices and consequences of the crisis on food markets. They also formulated tasks for the future, including analysis of trade based on consumer preferences for certain production methods and in terms of understanding the impact, i.e. mitigation of the consequences related to the climate change, and, accordingly, the formation of forecasts on the adaptation of food markets to it. According to the authors, this paper specifies quite relevant instruments to explain trends and fluctuations in world prices and consequences of the crisis on food markets.

It is possible to distinguish the article by N. Farhadi and S. Moosavi [6] as an example of studying the forecast of the interaction between investments in an agrocompany and competition in the industry. The authors selected a statistical aggregate that consists of all companies listed at the Teheran stock exchange from 1989 to 1993. 129 companies were selected as a sample for the study. The work used a multidimensional regression. The generalized estimation was carried out by the least squares method (EGLS). The data of the obtained model and the estimated developed hypothesis were verified. The results show a considerable and direct relationship between them. The use of the multidimensional regression model, as well as the generalized estimation approach by using the least squares method, is of great scientific interest.

In their work Cloé Garnache, Pierre Mérel, Richard Howitt and Juhwan Lee offered a new information method for calibrating the shadow values of constraints in positive mathematical models of agricultural supply programming [8]. The shadow values are chosen to minimize the deviation of the model from the observable costs related to the activity and data input, which improves the informational basis of the calibrated model. The supposed elasticity of demand for nitrogen minimally depends on the choice of shadow values. However, the predicted environmental results differ, because this choice has the impact on the distribution of nitrogen in regions and cultures. In the work, the mathematical model of agricultural supply programming is urgent.

In their work K. Anderson, S. Jha, and S. Nelgen summarize the latest forecasts of food

markets up to 2030 under various scenarios and then analyze data on how trade policy restrictions are usually changed to protect national markets from short-term fluctuations of international prices around their long-term trends. The authors argue that long-term trends in prices for agricultural products have political consequences for food security, which is as important as the trends related to short-term price leaps for the trend [2]. This work is of considerable scientific interest because it contains a methodology for determining long-term trends.

Such researchers as A.I. Altukhov, V.V. Drokin, and A.S. Zhuravlev consider today's fundamentally new social and economic situation in the agrarian area [1]. In their opinion, it does not fit into the framework of the current national agrarian policy as a long-term instrument for the economic regulation of the agro-food market and state support for the agrarian sector. It is possible to ensure food security based on import substitution in the context of globalization of national agro-food markets under macroeconomic conditions that contribute to the development of the competitive agricultural sector [11]. The main reason constraining the development of the industry is the nonequivalent interbranch exchange that is not favorable for agriculture. The article offers and tests the author's model (variant) of the methodical scheme for estimating the impact of price interindustry relations and state financial support (in the form of subsidies) of agricultural organization on their profitability formation [13].

MATERIALS AND METHODS

It is important to understand trends (forecasts) of the parameters of problem sectors of the agro-food market that are based on a comprehensive analysis of the activities of these markets, identifying the existing problem sectors and developing offers for improving management tools.

The study objects are the most important problems of strategic development of food groups and resources of the food market.

The materials of this study include the statistical data of the food product groups under study that are found in public sources and on official websites, as well as materials of the food groups submitted to the authors under official requests made within the state task.

The conducted research used such methods as analysis and comparison, induction and deduction methods, graphical analysis method, and the generalization method. Based on assessing methodological approaches, defining production opportunities and the capacity of the food market, the authors offer a system of measures to solve the above problems. It consists of the following stages:

– Stage 1: collecting and processing the initial information,

– Stage 2: developing methods to estimate the capacity of the agro-food market,

– Stage 3: developing the forecast of the food market development, and

–Stage 4: developing offers on the elimination of shortcomings.

At the first stage, it is necessary to carry out the following activities: to obtain official data on the food market by requesting Rosstat or marketing agencies, and adding the volume of the informal market (35-40%)to them; to collect and to analyze statistical data on the population size; and to calculate the volumes of security for each commodity group per person.

The second step of the first stage is to systematize data, to make up grouping and analytical tables, dynamic series of analyzed indicators, diagrams.

This stage of the information analysis is preparatory because it makes the quantitative and qualitative estimation of the food market capacity.

The third stage is to define production opportunities and potential capacity.

The potential capacity will be interpreted as the maximum possible sales volume. At the same time, the volume of sales is a set of potential consumers who buy food products based on physiological standards of consumption. However, at the same time, the potential capacity of the food market cannot be achieved, because consumers have certain

restrictions: the profitability of the population, financial constraints, consumption limitations, etc.

At the fourth stage, the results of the real and potential capacity of the market of the main groups of food products are compared. Using the comparative analysis, it is possible to identify the provision of the potential food product capacity, which allows defining the possibility of exporting this product to other regions, as well as importing deficit products under a considerable excess of the real capacity over the potential.

RESULTS AND DISCUSSIONS

Based on estimating methodological approaches, defining the potential capacity of the food market, the authors offer a system of measures to solve the above problems. It consists of the following stages.

The first stage results in obtaining analytical data that are a basis for defining the potential capacity of the food market.

At the second stage, it is necessary to determine the real capacity of the food market. It is defined as the sum of the volume of production, the volume of import by trade organizations, the volume of surplus in trade organizations and the volume of state reserves, minus the volume of export:

$$E = V_{pr} + V_{im} + V_{surp} + V_{sr} - V_{exp}$$

where: E is the real capacity of the food market,

V_{pris} the volume of food production,

V_{imis} the volume of food import,

V_{surpis} the volume of food surplus in trade organizations,

V_{sris} the volume of state reserves, and

V_{exp} is the volume of food export.

At the same time, these indicators are calculated as the total volume of sales of the product group under consideration.

The third stage is the determination of the potential capacity.

The required capacity will be interpreted as the maximum possible sales volume. At the same time, the volume of sales will be considered as a set of potential consumers who buy food products, based on physiological standards of consumption. However, at the same time, it is impossible to achieve the potential capacity of the food market because consumers have certain restrictions: the profitability of the population, financial constraints, consumption limitations, etc.

When calculating the potential capacity of the food market, annual consumption rates per person or medical consumption rates and the total size of the population are used:

$$C = S_c \times T_P \text{ or } C = S_{mc} \times T_P$$

where: C is the capacity of the food market,

S_c is the standard of food consumption by one person,

S_{mc} is the standard of medical consumption of food by one person, and

T_p is the total size of the population.

The authors think that in order to define the consumption standard more accurately, it is necessary to divide the population of the country into the following groups:

- by the intensity of consumption (with a high, medium, and low degree),
- by age (children, youth, employable population, pensioners), and
- by the territory of residence (urban, rural population).

At the fourth stage, the results of the real and potential capacity of the market of the main groups of food products are compared. Using the comparative analysis, it is possible to identify the provision of the potential food product capacity, which allows defining the possibility of exporting this product to other regions, as well as importing deficit products under a considerable excess of the real capacity over the potential.

It is reasonable to define the capacity of the market of agricultural enterprises on the basis of secondary data of state or regional statistics. The ratio of the turnover of an agricultural enterprise to the capacity of the market gives the market share of this enterprise. The market share of the enterprise can be characterized as an objective indicator that can generalize the result of the competition in the market [12]. A selective

comparison of the main positions of agricultural production and food industry indicates that in most cases the change of the trade balance in physical volumes is considerably compensated by the change in production, but the production growth exceeds the growth in the trade balance only for poultry meat and flour.

To create the terms and conditions for sustainable development and optimal functioning of the food security system, it is necessary to forecast the least efficient factors calculated on the basis of the dynamics of minimum (medical) standards and consumption levels of food groups at average rates (Table 1) and volumes of consumption, production and sales of food product groups in 2013-2016 at minimum and average rates for three groups (Table 2).

Table 1. Dynamics of Minimum (Medical) Standards and Food Consumption at Average Rates for Three Groups

Groups of products	Minimum standards by population groups, (kg per year per person)				Dynamics of food consumption at average rates for three groups (tons)			
	Employable population	Pensioners	Children	Average standard for three groups	Average consumption at average standards for three groups in 2013	Average consumption at average standards for three groups in 2014	Average consumption at average standards for three groups in 2015	Average consumption at average standards for three groups in 2016
Population, thous. people					**143,347**	**143,667**	**146,267**	**146,545**
Bakery and pasta in terms of flour, cereals, legumes, in total	126.5	98.2	77.6	100.8	14,449,377.6	14,481,633.6	14,743,713.6	14,771,736
Potatoes	100.4	80.6	88.1	95.5	13,689,638.5	13,720,198.5	13,968,498.5	13,995,047
Vegetables and melons	114.6	98.0	112.5	108.4	15,538,814.8	15,573,502.8	15,855,342.8	15,885,478
Fruits, berries and grapes	60	45.0	118.1	74.4	10,665,016.8	10,688,824.8	10,882,264.8	10,902,948
Meat and meat products, in total	58.6	54.0	44.0	52.2	7,482,713.4	7,499,417.4	7,635,137.4	7,649,649
Milk and dairy products in terms of milk, in total	290	257.8	360.7	302.8	43,405,471.6	43,502,367.6	44,289,647.6	44,373,826
Eggs	210	200	201	203	29,099,441	29,164,401	29,692,201	29,748,635
Fish and fish products	18.5	16.0	18.6	17.7	2,537,241.9	2,542,905.9	2,588,925.9	2,593,846
Sugar	23.8	21.2	25.8	22.3	3,196,638.1	3,203,774.1	3,261,754.1	3,267,953
Oil	11.0	10.0	5.0	8.7	1,247,118.9	1,249,902.9	1,272,522.9	1,274,941

Source: Compiled by the authors on the basis of the Federal State Statistics Service data (www.gks.ru)

Table 2. Consumption, Production and Sales of Food Products in 2013-2016 at Minimum and Average Standards for Three Groups

Groups of products	Dynamics of food consumption at average standards for three groups (thous. tons)				Production of food products groups in, thous. tons		
	2013	2014	2015	2016	2013	2014	2015
Bakery and pasta in terms of flour, cereals, legumes, in total	14,449.4	14,481.6	14,743.7	14,771.8	18,036	18,162	1,8213
Potatoes	13,689.6	13,720.2	13,968.5	13,995.0	30,199	31,500	33,600
Vegetables and melons	15,538.8	15,573.5	15,855.3	15,885.5	16,109	15,500	16100
Fruits, berries and grapes	10,665.0	10,688.8	10,882.3	10,902.9	2,941.5	2,995.6	2903.3
Meat and meat products, in total	7,482,713.4	7,499,417.4	7,635.1	7,649.6	8,544.2	9,070.3	9,565.2
Milk and dairy products in terms of milk, in total	43,405.5	43,502.4	44,289.6	44,373.8	30,700	30,790.9	30,796.9
Eggs, mln	29,099.4	29,164.4	29,692.2	29,748.6	41,286	41,860	42,571.7
Fish and fish products	2,537.2	2,542.9	2,588.9	2,593.8	3,789	3,725	3,829
Sugar	3,196.6	3,203.8	3,261.8	3,267.9	4,959	5,249	5,743
Oil	1,247.1	1,249.9	1,272.5	1,274.9	3,934	4,976	4,655

Source: Compiled by the authors on the basis of the Federal State Statistics Service data (www.gks.ru)

In order to forecast the indicators of the food production and consumption market taking into account the size of population, Excel and official statistical reporting data for the previous ten years (not more) were used in order to forecast trends for subsequent years.

In the authors' opinion, it is possible to resolve this problem by using the following model (1):

$$H_t = f(X_{t(11)}) + C(X_{t(11)})$$

where: H_{tis} the annual value of the indicator t,

$f(X_{t10})$ is the function of average t (11) for 11years, and
$C(X_{t10})$ is the characteristic of the model that shows the forecasted indicators for future years based on the previous ones; in this case, 11 years.
It is necessary to calculate the function $f(X_{t11})$ as an average.

According to the above analysis of Table 2, the following types of food groups have the greatest deviation from the required minimum: fruits and berries (31.7%), and milk and dairy products (70.7%).
On average the minimum consumption rate for the consumer group "fruits and berries" is 74.4 kg per person. Based on this, their necessary production is calculated (Table 3)

Table 3. Dynamics of Gross Collection, Actual Consumption of Fruits, Berries and Grapes Per Capita

Year	Population, thous. persons	Gross collection of fruits, berries and grapes, thous. kg	Consumption per capita, kg	Required production of fruits, berries and grapes, thous. kg (with a minimum rate of 74.4 kg per person)
Actual indicators				
2003	145,000	3,451,000	23.8	10,778,000
2004	144,200	3,935,000	27.2	10,728,000
2005	143,500	3,710,000	25.8	10,676,000
2006	142,800	2,174,000	15.2	10,624,000
2007	142,200	2,818,000	19.8	10,580,000
2008	142,800	2,669,000	18.6	10,624,000
2009	142,700	3,067,000	21.4	10,617,000
2010	142,800	2,473,000	17.3	10,624,000
2011	142,900	2,927,000	20.4	10,632,000
2012	143,000	2,931,000	20.5	10,639,000
2013	143,300	2,941,500	21	10,662,000
2014	146,090	2,995,600	21	10,869,096
2015	146,267	2,903,300	20	10,882,265
2016	146,545	3,300,000	22.5	10,902,948
2017	146,877	2,880,000	19.6	10,927,649
2018	**146,904**	**3,350,000**	**22.8**	**10,929,658**
2019	**147,500**	**11,000,000***	**74.6**	**10,974,000**
2020	**147,900**	**13,000,000***	**87.9**	**11,003,760**
2021	**148,200**	**13,300,000***	**89.7**	**11,026,080**
2022	**148,500**	**13,500,000***	**90.9**	**11,048,400**

Source: Compiled by the authors on the basis of the Federal State Statistics Service data (www.gks.ru)

At this stage of development, one of the most important problems of the country's food security is the liquidation of disproportions in the structure of food production, the optimization of its quality and the creation of terms and conditions for the competitiveness of the national food security system. It resulted in the following:
–Processes related to the formation and development of a bimodal type of the economic structure of the national food security system characterized by large-scale production (agroholdings), liquidation of the small and medium-sized business sector in agriculture, its underdevelopment in processing, and agro service of the national agroindustrial complex,
–The imperfection of the program-targeted management of the development and functioning of the national food security system, and
–Impact of the globalization of food markets due to entering the WTO and liabilities to further use the potential of the national food security system.
In practice, management of the national food security system development can be explained by its imperfection, taking into account the consistency and predictability principle.
The situation on the food market is characterized by the achieved food security parameters for the main groups of commodity supply, and the inability to achieve them in separate but significant areas (milk, beef meat, vegetables and fruits).

CONCLUSIONS

Based on the study, it is possible to note that the creation of terms and conditions for sustainable development and functioning of

the food security system involves the development of programs that suppose:

•Optimization of the parameters of the economic structure and its formation in regional food security systems by the product type in accordance with the available resource potential and the mechanism for attracting development resources (budget funds, credit sources, citizens' funds),

•Improvement of the mechanism of the program-targeted regulation of the development and functioning of regional food security systems in accordance with the principles of the territorial and product approach instead of the existing territorial and sectoral approach.

A prerequisite for this is the creation of the terms and conditions for the sustainability of rural areas according to parameters of the rural population's employment in order to form a high-quality labor potential.

The problem can be resolved by improving the mechanism of managing the development of the national food security system and activating the innovative approach to organizing the improvement of the mechanism for regulating the food market development.

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