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Assessment of Food Self-Sufficiency and Food Independence Based on the Analysis of Production and Consumption Data

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Abstract. The paper considers the problem of different understanding of the content of food self-sufficiency and food independence, the problem of methodology for assessing these criteria as components of food security. The author made an attempt to systematize the indicators according to the differences in the assessment method and the purpose of indicators, carried out a critical analysis of the methods. The author compares the indicators developed by The Food and Agriculture Organization (FAO) and the CIS Statistical Committee (Russia), an analysis of the method that takes into account rational nutritional standards and the method for assessing the overall level of independence of the country, included in the Food Security Doctrine. There were proposed modifications of the methods for calculating indicators by the author.

1. Introduction

The problem of food self-sufficiency and food independence in Russia has long been regarded as the leading direction of food security policy. In the future, the attention of researchers began to focus on other aspects of food security. Meanwhile, food self-sufficiency and food independence have not lost their relevance. Last years showed that this aspects have great importance in conditions of sanctions restrictions and other external risks and challenges, including the pandemic. In our opinion, the issues of methodology for assessing food self-sufficiency and food independence deserve a separate study.

The concepts of self-sufficiency and independence are often used by Russian authors as synonyms, since for a long time their content was not fully determined. Even in the Project Decree of the President of the Russian Federation "On Amendments to the Food Security Doctrine" 2015 [1], the assessment methods developed in 2010 in the Food Security Doctrine and often criticized by economists remained unchanged, and no distinction was made between the concepts of independence and self-sufficiency. As a result, the authors use different assessment methods.

The methods are based on food Balance Sheets. The difficulty in choosing a method is due to the presence of two points of view. It is possible to approach the assessment from the point of view of providing the national or regional market with food products from its own resources in conjunction with purchases of food products from abroad or other regions. The second point of view is that it is should assess food security only at the expense of our own production. This means different assessment methods.



2. Analysis of methods for assessing food self-sufficiency

The most fully described methodology for calculating indicators is contained in the methodological recommendations developed for the CIS countries [2]. The Food and Agriculture Organization of the United Nations has also developed similar indicators, the calculation method of which is very different from the Russian ones. First, let us analyze the indicator of self-sufficiency according to the Russian and FAO methodology. The table 1 presents the methods for calculating the indicator and short critical comments.

Table 1. Comparison of methods for calculating the indicator of self-sufficiency in the Russian methodology and FAO methodology.

Formula	Comments
CIS Statistical Committee [2]	
$SSR = \frac{FP}{IFC + L + PFC} \times 100\% \quad (1)$ <p>where: SSR- the self-sufficiency ratio; FP is the volume of production of a certain product (in physical terms); IFC- the volume of industrial consumption and processing for non-food purposes; PFC - personal consumption fund of the population; (L) - losses.</p>	<p>The level of self-sufficiency is estimated by the share of production in resources. We get the ratio of food production to total consumption (including production) and losses. This approach makes it possible to assess the factor of sufficiency of domestic production to cover the country's demand for food products, but exports are not taken into account, which greatly affects the size of the available volume of food in the domestic market.</p>
<p>The Food and Agriculture Organization (FAO) [3]</p> $SSR = \frac{FP}{FP + I - E} \times 100\% \quad (2)$ <p>where SSR–Self-Sufficiency Ratio; FP–Food Production I–Imports E–Exports</p>	<p>It is impossible to judge on the basis of the indicator whether or not there is enough food for the needs of the population. The indicator allows you to see only the share of own production in the volume of food available on the domestic market.</p> <p>The formula does not reflect the process in which the amount of total resources covers the amount of consumption, resulting in a stock. Therefore, for assessment purposes, in our opinion, comparison with the volume of consumption is more informative than with the amount of food on the market.</p>

In our opinion, methods (1) and (4) complement each other, but at the same time, the aspect of compliance of the population's consumption with norms can be assessed as a separate indicator. There are two possible solutions. Firstly, both indicators can be used, and secondly, it is possible to separately assess consumption of population in terms of compliance with rational nutritional norms. In the second case, the ratio of actual and normative indicators is calculated.

3. Analysis of methods for assessing food independence

Indicators with identical calculation methods are simultaneously recommended for assessing food self-sufficiency and for assessing food self-sufficiency, as will be shown below. Comparison of the FAO and CIS Statistical Committee methods is presented in Table 2.

The first difference between the formulas is that in formula (7), the denominator is the amount of resource in the market, taking into account that part of the product is exported, and in formula (6) everything that is produced by a region or country is taken. The guidelines state that the indicator represents the share of food produced in the country in the total resources of the domestic market. But

in reality, in formula (6), domestic resources are reduced by the size of exports, while in formula (2), the ratio of domestic production to the volume of products available on the market is considered. The second difference is that the Russian method includes reserves in the calculation. Comparison of formulas (6) and (2) made it possible to conclude that formula (6) can be replaced by formula (2).

Table 2. Methods for calculating the independence indicator.

Formula	Comments
<p>CIS Statistical Committee [2]</p> $\text{IDR} = \frac{\text{FP} + \text{Sb}_1}{\text{Sb}_2 + \text{FP} + \text{I}} \times 100\% \quad (3)$ <p>where: IDR- Import dependency ratio FP is the volume of production of a certain product (in physical terms); Sb₁ - part of stocks at the beginning of the year, characterizing the volume (in physical terms) produced in the country in the previous year (the calculation is carried out according to the ratio of production and imports in the previous year); Sb₂ - stocks at the beginning of the year; I - import of a certain product (in physical terms). The Food and Agriculture Organization (FAO) [3]</p> $\text{IDR} = \frac{\text{I}}{\text{FP} + \text{I} - \text{E}} \times 100\% \quad (4)$ <p>where: IDR- Import dependency ratio FP–Food Production I–Import E–Export</p>	<p>The indicator represents the share of food produced in the country in the total volume of resources of the domestic market.</p> <p>The method description does not disclose how Sb₂ is calculated.</p> <p>The indicator has a general principle with the SSR estimation method according to the formula (2).</p> <p>The indicator represents the share of imports in the volume of food in the domestic market.</p> <p>This indicator complements SSR (2), and even duplicates it.</p>

The national level of assessing the overall level of food independence is reflected in the method proposed by the specialists of The Russian Presidential Academy of National Economy and Public Administration (The Presidential Academy, (RANEPA). The peculiarity of the method is that it is based on comparing the cost of spending on consumption [11].

$$\text{IDR} = \left(1 - \frac{\text{IC} - \text{EC}}{\text{HSF}} \right) \times 100\% \quad (5)$$

where:

IC is the cost of imports;

EC –the cost of export;

HSF - expenditures of the country's population on food.

This formula estimates the share of spending on the purchase of food of own production in the total amount of spending on food. According to O.S. Sukharev [9] the formula (8) converted to the form presented below is equivalent to formula (1):

$$\text{IDR} = \frac{\text{HSF} - \text{IC} - \text{EC}}{\text{HSF}} \times 100\% \quad (6)$$

Let us analyze formula (9). Since imports and exports have different volumes and structure, the exchange rate will have a different effect on the value of the indicators in the formula, which will cause

the effect of distortion of the estimate, difficulties in comparing with threshold indicators. If the ruble falls, the cost of imports and the rise in domestic food prices will cause an additional decline in the indicator. With strong fluctuations in the exchange rate, we will have indicators of different years that cannot be compared.

In our opinion, this formula is not equivalent to formula (1), since it operates with the cost, not the amount of food, and contains dependence on the foreign exchange market and the structure of exports and imports. The choice of physical volumes for calculations is more consistent with the task of assessing self-sufficiency. Price issues and the impact of purchasing power on consumption is another area of integrated food security assessment. Thus, methods based on the comparison of physical volumes seem to be more adequate to the task of assessing self-sufficiency. The problems of prices and the influence of purchasing power on consumption are related to the problems of food availability and belong to another area of analysis.

4. Results

Based on the analysis, the author came to the conclusion that it is necessary to make changes into the formulas. First, the author believes that when assessing self-sufficiency, one should proceed from the volume of not all production, but the available part of own production. It is necessary to find a relationship between the part of the product that is actually supplied to the domestic market and the total volume of products consumed. Stocks need to be maintained at a constant level, and this becomes a separate assessment and control task. In addition, as a rule, the change in reserves is insignificant, therefore this value can be neglected. Below is the author's modification of formula (1):

$$SSR = \frac{FP - E}{PFC + L + IFC} \times 100\% \quad (7)$$

Secondly, to carry out an assessment from the point of view of the provision of standard consumption, we propose to modify formula (4). Since the denominator does not contain a part of production consumption, which has a large contribution to the volume of domestic consumption, the numerator should also be reduced by the amount of production consumption. For example, in 2017 industrial consumption amounted to 9140.5 thousand tons of potatoes, and personal consumption amounted to 13224.6 thousand tons [12]. For a higher accuracy of the estimate, you can also take into account losses and exports. Below is a new formula:

$$SSR = \frac{FP - IFC - E - L}{NPFC} \times 100\% \quad (8)$$

Taking into account the problem of using formula (8), the author proposes not to use this method, but to calculate the overall level of independence as the geometric mean:

$$IDR = (IDR_i \times IDR_j \dots IDR_n)^{1/n} \quad (9)$$

where $IDR_i, IDR_j, \dots, IDR_n$ – indicators of independence for the main types of products, calculated by formulas (2) or (7).

5. Conclusions

The food security assessment methodology was significantly improved in 2019. Now food independence is described by several indicators, and self-sufficiency is one of them. However, there is still no uniform recognition of the methods, it is difficult to compare and use the indicators correctly. All considered in the paper methods are not free from some limitations. Choosing a method, the analyst must clearly define concrete task of the assessment, since not all known methods directly correspond to the task of the assessment. The analysis showed that some indicators can only serve as an indirect assessment and

it is necessary to use several indicators to assess one aspect. The author compared the methods, showed contradictions and limitations in the methods, and also proposed his own modifications of the indicators.

The FAO method does not include consumption in the calculation of self-sufficiency indicators. Russian methodology indicators make it possible to assess the extent to which domestic production provides food consumption. However, this approach to assessment is subject to criticism among Russian scientists, who believe that it is necessary to assess the sufficiency of their own production not in relation to actual consumption, but in relation to rational nutritional standards. The author believes that such an assessment is necessary, although it may be equivalent to a separate assessment of how the actual consumption meets the norms. Nevertheless, taking into account the existing shortcomings, the author proposed a modified formula that allows one to assess production in relation to standard consumption.

To assess independence, the modern Russian methodology suggests using various indicators. One of them is the share of own production in the volume of available resources. The author proposes not to take into account the value of exports, which is consistent with the approach to determining the volume of the internal market that FAO uses.

The indicator, in the calculation of which the cost is used, rather than the physical volumes of imports and exports, reflects the effect of the factor of the ruble exchange rate, which may distort the result of the assessment. In any case, such methods will not allow using indicators to analyze changes in the state of food independence or to compare regions. Therefore, in our opinion, the Russian method for assessing the general level of food independence, considered in the work, should be revised. The author proposes to use the geometric mean method, having previously calculated the independence indicators for different products.

All the proposed modifications of the calculation methods are easy to use, since they are focused on the Food Balance Sheets data of the Federal State Statistics Service of the Russian Federation and FAOStat.

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