



Managerial aspects in forming the optimal system of indicators of country's food security level

Aspectos gerenciales para la formación de un sistema óptimo de indicadores de seguridad alimentaria

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ABSTRACT:

The process of food security governance is accompanied by organized monitoring of the nature of changes, their quantitative and qualitative assessment in order to prepare appropriate recommendations and management decisions, which substantiates the need to create an optimal system of indicators for assessing the food security level. Using the example of Ukraine, the paradox of these indicators has been determined, since the decrease of the Global Food Security Index results in the decrease in the level of hunger in the country. The system of indicators makes it possible to carry out food security analysis rather quickly, and the results of the assessment can be used by authorities in planning and developing agrifood policy measures.

Keywords: productivity, level of economic affordability, Global Food Security Index, GDP.

RESUMEN:

El proceso de gobernanza de la seguridad alimentaria va acompañado de un seguimiento organizado de la naturaleza de los cambios, su evaluación cuantitativa y cualitativa con el fin de preparar recomendaciones apropiadas y decisiones de gestión, lo que confirma la necesidad de crear un sistema óptimo de indicadores para evaluar el nivel de seguridad alimentaria. Utilizando el ejemplo de Ucrania, se ha determinado la paradoja de estos indicadores, ya que la disminución del Índice Global de Seguridad Alimentaria resulta en la disminución del nivel de hambre en el país. El sistema de indicadores permite llevar a cabo análisis de seguridad alimentaria con bastante rapidez, y las autoridades pueden utilizar los resultados de la evaluación para planificar y desarrollar medidas de política agroalimentaria.

Palabras clave: productividad, nivel de asequibilidad económica, Índice Global de Seguridad Alimentaria, PIB

1. Introduction

In the context of globalization and integration of the world economy, the problem of food security is one of the most important problems. The number of people suffering from hunger and poverty exceeds 1 billion, even more, 2 billion inhabitants of the planet suffer from so-called masked forms of hunger that are caused by underconsumption of essential minor nutrient: iodine, iron,

vitamin A, etc. Whereby 50% of the world's food products are consumed by the most developed countries with only a fifth of the world's population. The situation is complicated by the frequency of food, financial and economic crises. Regardless of the level of socio-economic development, any country seeks to solve the problem of a full supply of its population with food.

2. Problem setting

In the context of European integration, which implies openness of the domestic and foreign food markets, steady monitoring of the country's food security indicators is necessary, which will enable to quickly react to changes and formulate the corresponding state policy. This requires the formation of a unified and, at the same time, the most relevant and accurate system for assessing the country's food security, not only with the aim to determine its level but to develop and implement the most optimal directions of the state's food policy.

Food security governance aims to counteract existing and potential threats that may lead to reduced production volume, poor public access to important food. Therefore, food security governance is a multifaceted activity that characterizes a certain state and prospects of the food system and requires a multicriteria assessment.

In this regard, it is obvious that any country wishing to avoid the risks associated with a proper food supply should provide citizens with food, especially in times of market uncertainty (Markina et al., 2019).

The level of food security is a priority component of the system of measuring the most important parameters of the country's economy, which reflect its state and are components of national and regional programs of socio-economic development. Food security indicators are used for this purpose (Sabluk, 2001). In practice, integral indicators or indices of the level of food protection of population are also used (Baker Tilly, 2018).

Thus, the problems in the formation of the food security system at different levels are studied in the works of Ukrainian and foreign scientists: Klaus von Grebmer, Jill Bernstein, Fraser Patterson, Markina I., Safonov Yu. ect.

The goal of the article is to form an optimal system of indicators for assessing the level of food security of the country.

3. Literature review

Food security is an integral part of national security, a condition for preserving nationhood and sovereignty, the most important component of demographic policy, the life-support system, a prerequisite for supporting health, physical activity and quality of life of the country's population.

According to the definition of the Food and Agriculture Organization of the United Nations (FAO), food security is a condition characterized by the continuous physical, social and economic access of all people to sufficient, nutritious and safe food, which is necessary for a healthy and active life (World Food Summit, 1996).

According to the Federation of American Societies for Experimental Biology, food security is all people's access at any time to adequate food for an active, healthy lifestyle and includes at least the availability of nutritious and safe food; providing the opportunity to buy food without appealing to emergency food aid (Raiten, 1990).

The Committee on World Food Security (a body established on the recommendation of the World Food Conference (1974) to oversee changes in food security) identified food security as a three-pronged concept based on availability, affordability and stability in the early 1980s (United Nations, 1975).

In its turn, the OECD suggests using three characteristics when defining the notion of food security: availability, affordability and use (Clay, 2002).

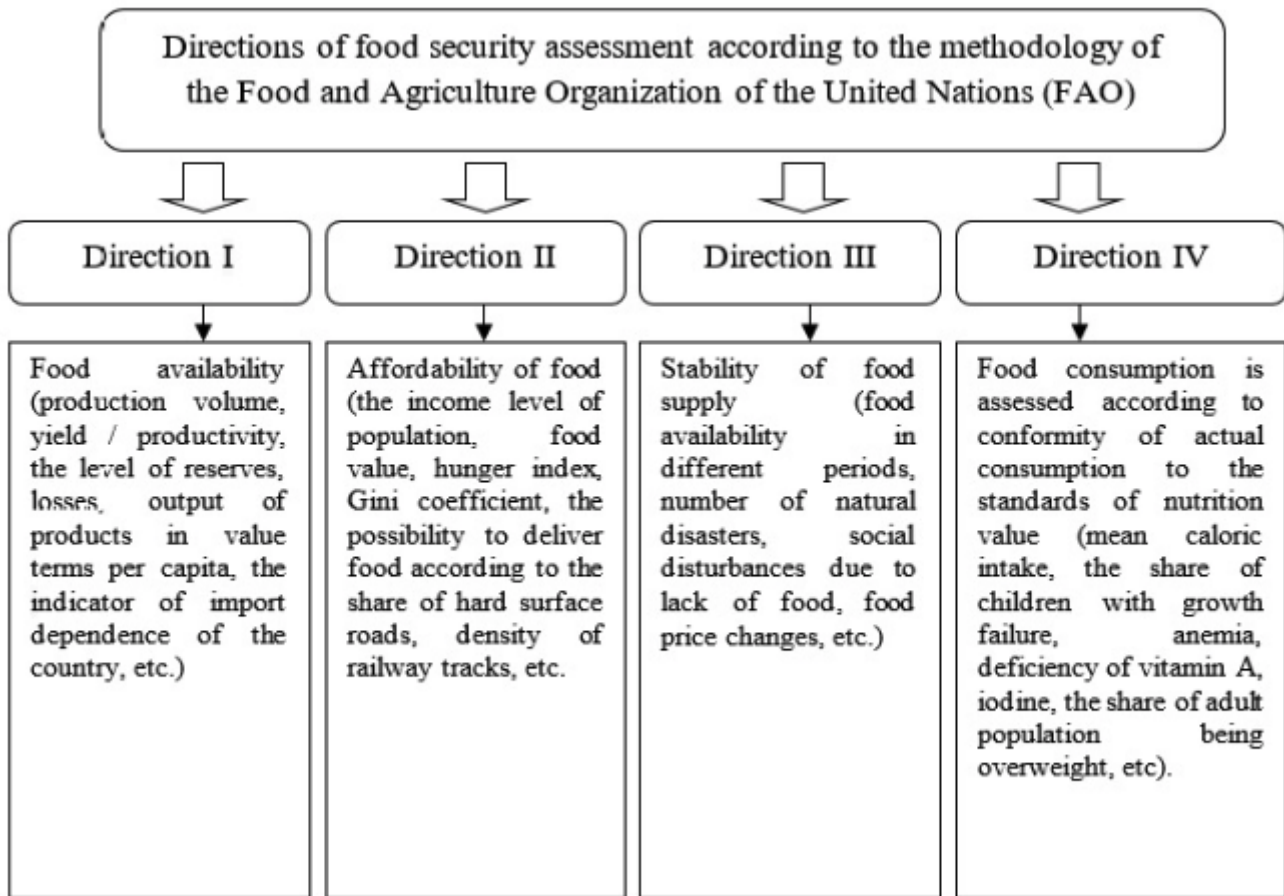
Having defined the semantic meaning of the term "food security" in the context of its various use in different subject areas of research, it is advisable to consider and characterize the existing methods of food security assessment. In international statistics, food security is rated on the average indicator "the level of daily calorie intake of population".

The methodology suggested by the Food and Agriculture Organization of the United Nations (FAO) is based on the system of indicators grouped into four directions (fig. 1).

A foreign methodology that is deserving attention is the food security assessment methodology used in Japan. It is carried out on the basis of the indicators of: food self-sufficiency, food energy,

consumption of primary calories (Anishchenko, 2013).

Figure 1
Directions of food security assessment according to the methodology of the Food and Agriculture Organization of the United Nations (FAO)



(formed by the authors based on the Food and Agriculture Organization of the United Nations, 2019)

In accordance with another approach, food security is suggested being determined by the integrated index of calculation of indicators in dynamics, in particular: dynamics of production of basic foodstuff per capita in kg per year; dynamics of consumption of basic foodstuffs per capita in kg per year; the level of self-sufficiency of subjects (of a state, a region, households) in basic foodstuff included in the consumer goods basket, %; the level of physical and economic affordability of food for different categories of consumers (nutritional breakdown; the share of food spending in the budget; consumption of basic foodstuff (per person, in kg per year) by groups of consumers with different income levels); the average calorie concentration of daily ration of the region's population of individual consumer groups, kcal; the level of compliance of the diet with scientific-based standards concerning energy value and the actual content of nutrients, etc (Basinskaya, 2008).

The Global Food Security Index developed by the department of economic intelligence and sponsor Corteva Agriscience, agriculture department DowDuPont examines three major «pillars» of food security – affordability, availability, and quality & safety. The index is a dynamic quantitative and qualitative benchmarking model based on the calculation of 28 unique indicators, which provides the goal of food security assessment in different countries of the world (Global Food Security Index, 2018).

The interest of the academic community in food security has contributed to the emergence of a large number of assessment methods and models. In the world practice, different indicators are used to evaluate the affordability of food at the micro- and macro-levels. At the macro-level, such indicators as inflation, exchange rate, duties and agricultural rates, food price indices and their changes are analyzed. At the level of individual households, access to health and social care services, especially in times of crisis, is considered in the context of food security (Ushachev, 2014; Markina et al., 2018b).

At the same time, existing methodologies for assessing and indicators of food security assessment face some methodological difficulties, in particular:

- first, the multidirectionality of research in this subject area has led to its essential expansion, and thus to the formation of a large number of food security assessment methodologies. As a result, most of the proposed food security assessment methodologies are focused on the characteristics of volume and dynamics of agricultural production, the analysis of price affordability of food products for population, the analysis of physical accessibility of certain foodstuff, etc. (Blaauboer et al., 2016; Jambor & Babu, 2017; Omarova et al., 2017);
- secondly, the use of the integral indicator does not directly answer the question in which area of food security governance public policy measures are ineffective or even wrong; in which area at the moment there are greater risks and threats, and what specific measures should be taken to improve the food situation. In a manner of speaking, the aggregates perform primary diagnostic functions quite well, but they are not effective enough to develop tactics and provide "treatment" (Rausser & Zilberman, 2014; Aceves & Amato, 2017; Herzfeld et al., 2017; Rogachev et al., 2018);
- thirdly, the methodology of weighing private indicators, which directly affects the integral indicator value. The arbitrary choice of scales largely depends on personal views and preferences of the researcher, which is a rather subjective method of presenting information to evaluate the overall picture. In addition, the relative importance of private indicators may vary for different countries and periods, so the use of general-purpose scales is considered to be inadequate. In any case, the information provided should leave the choice to the person empowered to make the decision and not to push him to certain conclusions based on specifically aggregated indicators. (Gumerov, 2016).

The absence of a common methodology for assessing food security eliminates the possibility of benchmarking, as different, incompatible indicators and criteria are often under consideration.

4. Materials and methods

The considered methodologies of food security assessment at different levels of management allowed us to group them on the basis of two approaches:

1) a sectoral one, according to which for each sphere certain indicators are applied, characterizing the efficiency of their functioning and regulation. In terms of a sectoral approach, food security indicators stand out in the sphere of production (output of agricultural products, the level of profitability of production of different agricultural products) and food consumption (average food consumption per capita, including individual regions);

2) a resource-potential approach, which enables to determine us the absolute and relative level of food security. The first is determined by the ratio of potential manufacturability (available resources) to the actual volume of their use. Relative efficiency shows the ratio of the final effect on costs (profitability of agricultural production).

Despite the diversity of existing food security assessment models, many of them are focused on assessing specific aspects of food security.

However, the considered food security assessment methodologies provide for calculation and analysis of a number of commonly used indicators and indices such as:

- the level of food self-sufficiency of a country, a region, which characterizes how a country or a region meets the needs of the population for different types of food products by means of local production (Ministry of economic development and trade of Ukraine, 2013; Ushachev, 2014; Blauboer et al., 2016; Global Food Security Index, 2018; Markina et al., 2018b; Rogachev et al., 2018; Food and Agriculture Organization of the United Nations, 2019);
- the degree of satisfaction of physiological needs of the population for food shows the actual volumes of consumption in comparison with rational norms (Ministry of economic development and trade of Ukraine, 2013; Ushachev, 2014; Jambor & Babu, 2017; Omarova et al., 2017; Global Food Security Index, 2018; Basinskaya, 2008; Food and Agriculture Organization of the United Nations, 2019);
- the level of economic affordability of food, which characterizes the possibility of buying food depending on the size of income of population and the level of food prices (Rausser & Zilberman, 2014; Herzfeld et al., 2017; Global Food Security Index, 2018; Food and Agriculture Organization of the United Nations, 2019);
- food quality (Rausser & Zilberman, 2014; Global Food Security Index, 2018; Food and Agriculture Organization of the United Nations, 2019);
- the ratio of production volumes and food consumption (Ministry of economic development and trade of Ukraine, 2013; Rausser & Zilberman, 2014).

Unlike the discussed methods, the proposed study is based on a grouping method that allows us to consider the issues of food security assessment and monitoring with the use of two types of indicators: the indicators of assessment of current and target condition of food security (insecurity) in terms of its main features, as well as the indicators of assessment of food security

risks and threats that are likely to lead to deterioration in food supply. Other research methods include monographic, economics and statistics ones.

The basis for the analysis of food security level was the following data: the Global Food Security Index for 2015-2018 and the Global Hunger Index for 2000, 2005, 2010, 2018. They were also used to form the optimal system of indicators for assessing the level of food security of the country.

5. Results

Thus, these indicators are the basis for most food security methodologies, as confirmed by the most common and world-famous methodology of the Global Food Security Index, which is calculated and published by The Economist with the support of DuPont company and provides for food security assessment of 113 countries (table 1).

Table 1
Matrix of negative and positive impact of factors on the level of food security of countries in the world according to the Global Food Security Index in 2018

VERY GOOD (TOP QUARTILE)		GOOD (3RD QUARTILE)		MODERATE (2ND QUARTILE)		WEAK (BOTTOM QUARTILE)	
	Score		Score		Score		Score
Slovakia	81,7	Belgium	68,5	Kenya	61,7	Egypt	54,7
Denmark	81,5	Burkina Faso	68,5	Ethiopia	61,3	Angola	54,5
Czech Republic	80,9	Rwanda	68,4	Cambodia	61,3	Mexico	54,5
Austria	80,2	Paraguay	68,1	Senegal	60,9	Tunisia	54,4
Hungary	79,2	Netherlands	67,9	Nicaragua	60,3	Panama	54,0
Switzerland	78,5	Niger	67,8	Honduras	59,5	Morocco	53,9
Poland	77,7	Kazakhstan	67,7	Chad	59,3	Guinea	53,1
Sweden	77,3	Norway	67,6	China	59,2	Qatar	53,0
France	76,0	Cote d'Ivoire	67,5	Bangladesh	59,1	Dominican Republic	52,9
Portugal	75,7	Burundi	67,2	Guatemala	58,8	South Korea	52,4
Germany	75,7	Thailand	66,4	Nigeria	58,7	Tajikistan	52,0
Uruguay	75,0	Zambia	66,2	Togo	58,7	Mozambique	51,9
Romania	74,7	Argentina	66,1	Haiti	58,4	Malaysia	51,9
Bulgaria	74,7	Tanzania	65,4	Algeria	57,8	India	51,7
Greece	74,6	United States	64,9	Costa Rica	57,8	Syria	51,3
Italy	74,3	United Kingdom	64,8	Sudan	57,7	Philippines	51,0

Canada	73,5	Mali	64,6	Nepal	57,7	Colombia	50,8
Russia	73,4	Madagascar	64,5	Azerbaijan	57,6	Singapore	50,3
Spain	71,9	Botswana	64,4	Ukraine	57,5	Israel	49,9
Finland	71,8	Jordan	63,5	South Africa	57,0	Ecuador	49,5
New Zealand	71,8	Pakistan	63,2	Ghana	56,7	Yemen	48,2
Japan	71,7	Brazil	63,1	El Salvador	56,6	Oman	46,9
Turkey	70,2	Australia	63,1	Sierra Leone	56,5	Saudi Arabia	46,9
Uganda	70,0	Belarus	62,9	Sri Lanka	56,3	Bahrain	46,6
Myanmar	69,6	Chile	62,7	Cameroon	55,6	Congo (Dem. Rep.)	45,0
Ireland	69,2	Uzbekistan	62,3	Kuwait	55,1	Indonesia	43,9
Malawi	69,2	Bolivia	62,1	Benin	55,1	Peru	42,6
Serbia	69,0	Venezuela	62,1	Vietnam	55,0	United Arab Emirates	40,7
Laos	69,0						

(formed by the authors on the basis of the Global Food Security Index, 2018)

For the first time, Singapore claims to be at the top in the Index rating in 2018. Singapore has been ranking high partly due to GDP growth per capita nearly up 30% since 2012 and partly due to consumer spendings on food that amount 6.9%. In addition to GDP growth, Singapore has the lowest tariff rates on agricultural imports among all countries in the Index.

According to the findings, low- and middle-income countries had the highest growth rates over the past year suggesting transition to more effective food security measures. Improving agricultural infrastructure and increasing capacity to supply the growing population with food are regarded as positive indicators (Agribusiness Today, 2018). Since 2014, ranking has been declining over the past five years – the country ranks 63rd with a total of 55.7. Considering Ukraine's ranking among the countries of the European region, it ranks the last – 26th (table 2).

Table 2
European country ranking according to the Global Food Security Index in 2018

Regional ranking	Country	Overall	Affordability	Availability	Quality and safety
1st	Ireland	85,5	87,8	83,6	84,8
2nd	United Kingdom	85,0	82,6	88,8	80,4
3rd	Netherlands	84,7	82,8	86,1	85,1
4th	Switzerland	83,5	82,2	86,1	79,8

5th	Finland	83,3	81,3	84,2	86,0
6th	France	82,9	80,5	83,8	86,5
7th	Germany	82,7	82,9	83,6	79,7
=8th	Norway	82,2	79,1	84,3	84,5
=8th	Sweden	82,2	82,0	81,7	83,9
10th	Austria	82,1	83,5	81,3	81,0
11th	Denmark	80,9	82,5	79,0	82,3
12th	Belgium	80,2	81,1	79,0	81,2
13th	Portugal	79,3	76,7	78,7	87,3
14th	Spain	78,0	79,2	74,9	83,6
15th	Italy	76,3	79,2	71,6	81,9
16th	Czech Republic	76,1	77,9	75,4	73,7
17th	Poland	75,4	76,4	75,0	74,1
18th	Hungary	72,8	75,6	70,5	72,0
19th	Greece	71,6	69,4	69,2	83,7
20th	Slovakia	70,3	73,6	69,4	64,6
21st	Romania	68,9	67,5	68,8	72,6
22nd	Russia	67,0	70,5	61,0	75,2
23rd	Belarus	65,7	67,6	63,4	67,1
24th	Bulgaria	64,5	70,1	60,0	63,2
25th	Serbia	59,8	63,2	57,4	57,8
26th	Ukraine	55,7	54,1	53,8	65,2

(formed by the authors on the basis of the Global Food Security Index, 2018)

According to the Index, the country's main strengths include a relatively small percentage of people below the global poverty rate (99.8 points out of 100). In addition, food safety indicators, a low level of food loss, non-prohibitive tariffs for agricultural imports, stability of production volumes and availability of food security programs are considered as strengths (98.4 points). Experts consider low GDP per capita, insufficient financing of research and recent development in the agricultural sector as well as risks of political instability as the most serious problems (2018 Global Food Security Index, 2018).

According to the Global Rating, the food security situation in Ukraine is the most negatively affected by the factors that are not related to purely agrarian problems, but connected to the general state of the economy: a high level of corruption, too high loan rates, the risk of political instability.

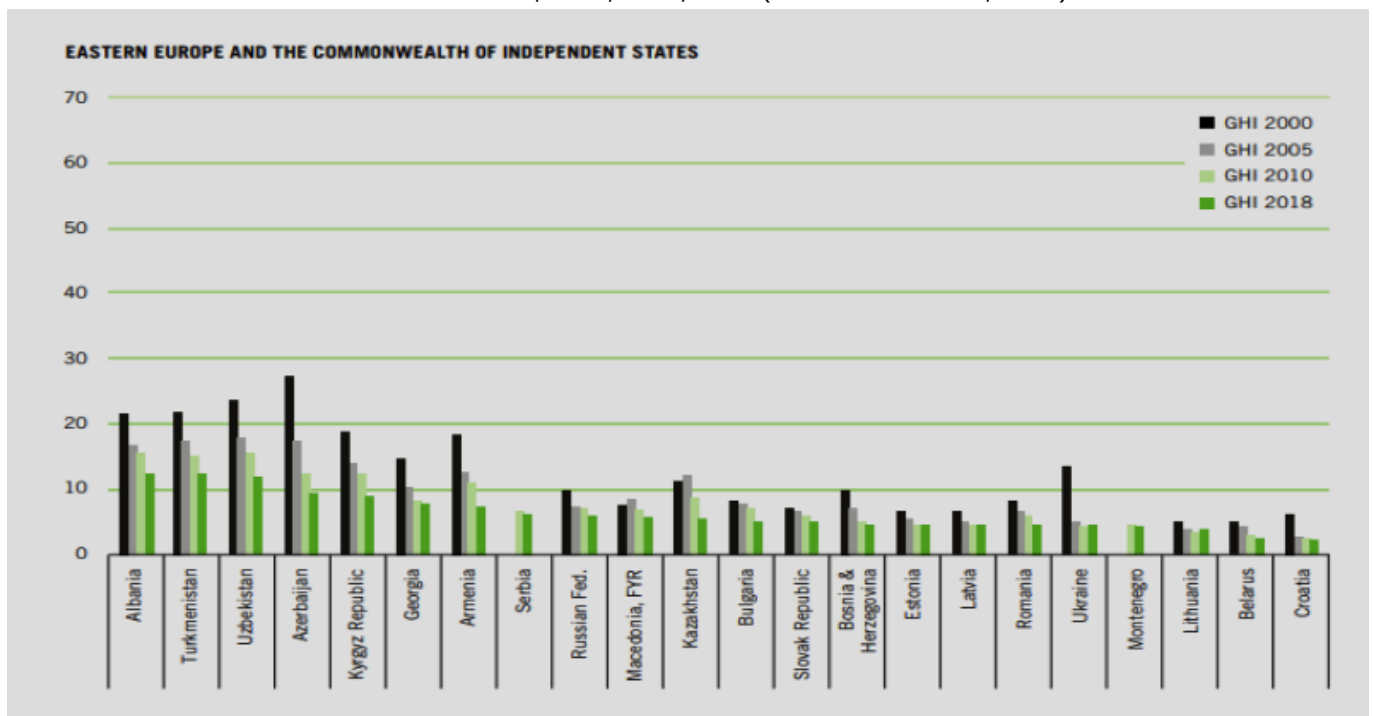
Therefore, improvement of the situation is directly related to a number of measures that will have positive effect on the overall state of the Ukrainian economy.

Some progress in this direction can be observed: the economy of the state has been growing even if slowly for several years running, and it is the agrarian sector which is the main driver of this growth. However, for Ukraine, which has a high agricultural potential, the current indicators should be considered as extremely low. Further positive changes require a more consistent fight against corruption, protection of investor rights, rising citizens' incomes. The immediate measures include increase of financing innovative projects in agriculture by the state and private companies, as well as liberalization of the agricultural land market.

At the same time, the methodologies discussed do not attach proper value to the level of hunger in the country, which, in the authors' opinion, is one of the main indicators of the country's food security level. In this case, it would be reasonable to take into account the Global Hunger Index (GHI), which is a tool designed to assess and monitor hunger at global, regional and national levels. International Food Policy Research Institute (Blaauboer et al., 2016) annually controls and evaluates the progress or regress in fighting hunger. The index consists of four indicators: the proportion of starving population, the proportion of children under five who are underweight due to severe malnutrition, the proportion of children under five who are developmentally disabled due to chronic malnutrition, and children's mortality rate. Countries are rated on a 100-point scale, where 0 is the best result and 100 is the worst. It should be noted that the rating does not include developed countries.

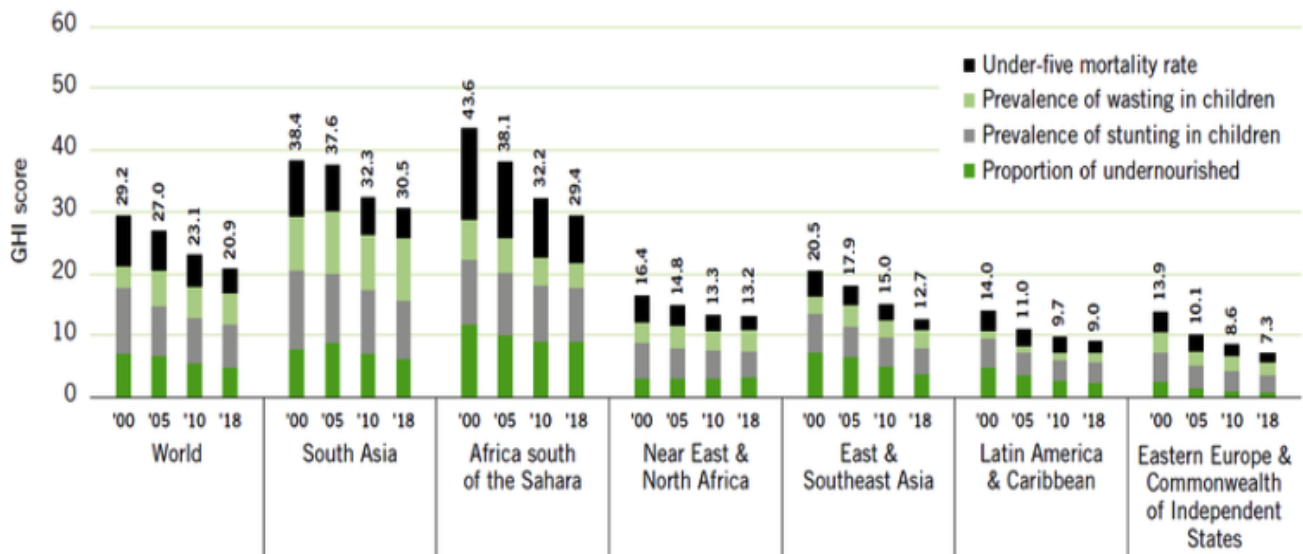
According to a survey of 119 countries, the level of hunger in Ukraine is one of the lowest. 13 countries from Eastern Europe and the CIS also appeared on a par with Ukraine, where there is not much starving population. These include Croatia, Belarus, Montenegro, Lithuania, Romania, Latvia, Romania, Estonia, Bosnia and Herzegovina, Slovakia, Kazakhstan, Macedonia and Russia (fig. 2).

Figure 2
Trends in change of the global index of hunger in Eastern Europe and the CIS in 2000, 2005, 2010, 2018 (von Grebmer et al., 2018)



The worst nutrition situation is observed in the Central African Republic, where there is more than half of the starving population. The RSA's score is 50.9. Researchers gave 43.5 points to the Republic of Chad, which is evidence of the difficult food situation in this country (fig. 3).

Figure 3
Global and regional 2000, 2005, 2010, and 2018 Global hunger index scores, with contribution of component (von Grebmer et al., 2018)



At the time when Ukraine ranks one of the lowest among the countries of Eastern Europe and the CIS and the world as a whole and has a value of less than 5.0.

6. Discussion

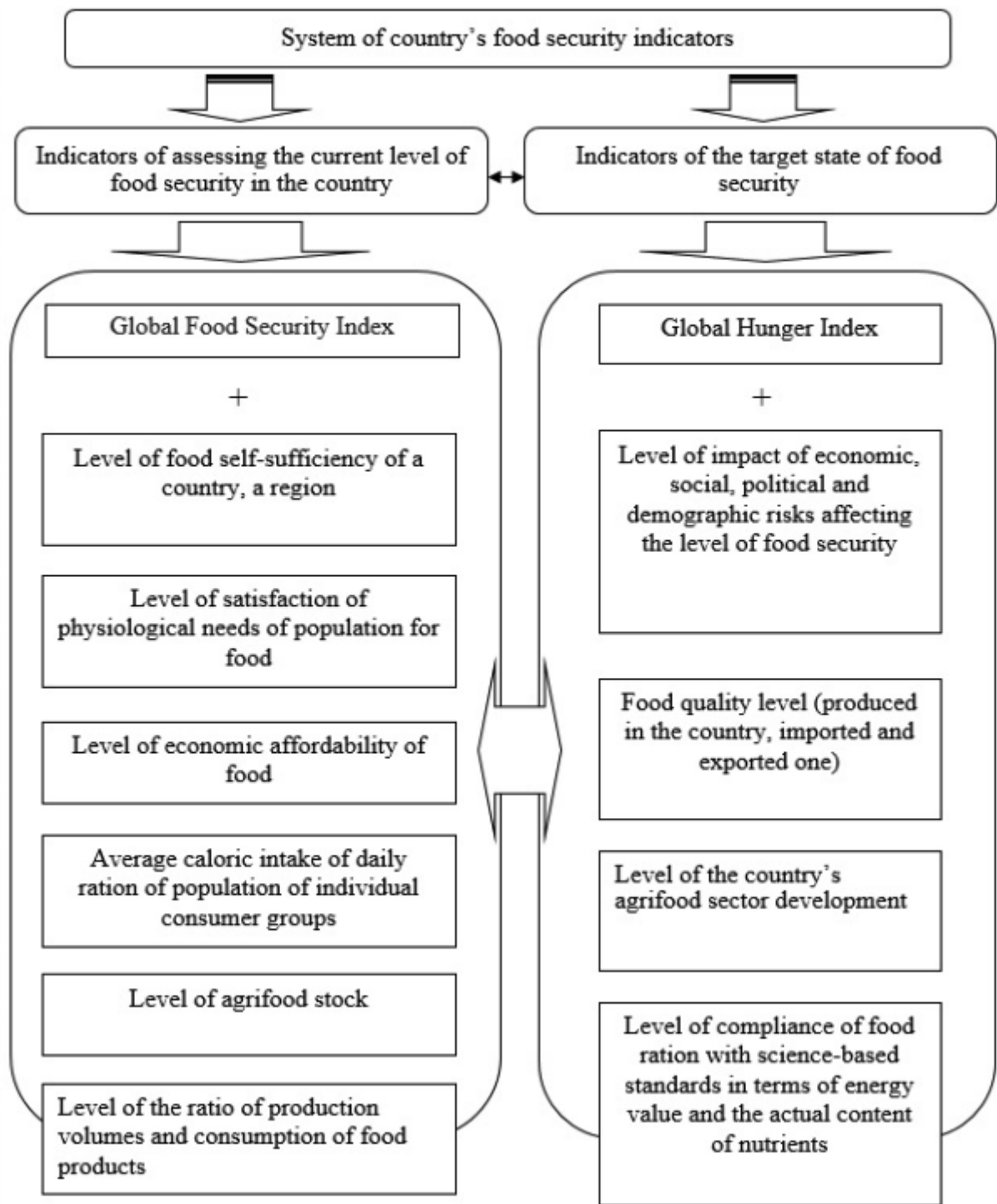
Therefore, comparing the values of the Global Food Security Index and the Global Hunger Index through the example of Ukraine, we should emphasize the decrease in the level of food security and at the same time reducing the global hunger index, which creates a paradoxical situation.

According to the dualistic nature of food security (supply – security), at least two types of indicators are required to assess and monitor its state: the indicators of assessing the current and target state of food security (insecurity) in the context of its main features, as well as the indicators of assessing food security risks and threats which are likely to lead to deterioration of food supply in the medium and long term (fig. 4).

The distinctive features of the proposed system of indicators are its complexity and flexibility, which will enable to make a comparative analysis of the country's food security level and offer corrective measures within the framework of the agrifood policy. The practicability of the proposed system of indicators of the country's food security level is substantiated by the possibility of reducing the measurement of indicators to the range of values of each indicator from 0 to 100. The proposed set of indicators and criteria for food security can be transformed, additional criteria and indicators of assessment may be introduced depending on the agricultural focus of the country and development of its agricultural production. The system of indicators makes it possible to carry out food security analysis rather quickly, and the results of the assessment can be used by authorities in planning and developing agrifood policy measures.

The developed system is quite laconic but at the same time informative. In addition, the proposed indicators are adapted to the system of domestic and foreign statistics and are fully provided with statistics data, and the legal framework makes it possible to use the standards of executive authorities in food security governance.

Figure 4
System of country's food security indicators (author's development)



With regard to the priority areas of food security governance of Ukraine, taking into account the Global Indices considered, it is reasonable to propose:

- steady monitoring of the agrifood market using operational services at local, regional, national and interstate levels;
- formation of mechanisms and regulators of the state support of domestic agricultural commodity producers in the sphere of investment and innovation activity;
- developing a system of measures to increase the affordability of food for low-income population;
- intensification of work on creation of information and consulting support of agribusiness and organization of its effective functioning;
- stimulating the personnel retention in rural areas;
- availability of benefits to local producers who support private agricultural business;
- improvement of the mechanisms for regulating food markets;
- improving the competitiveness of domestic products by making them of higher quality;
- change of financial support (including tax and credit one) of agricultural production and closely related branches of the national economy (production of agricultural machinery, mineral fertilizers, agrochemicals, etc.);
- strengthening the quality requirements for imported food, in particular for the content of chemical and biogenetic components that are harmful and dangerous to human health;

- creation of the necessary regulatory, scientific and technological, financial, information and personnel support for development of the domestic agro-industrial complex towards transferring to an innovative model of food security governance;
 - in the field of export-oriented food production: development of state financial support mechanisms, in particular, preferential taxation, preferential loans and preferential insurance for agricultural export production;
 - since food security is largely dependent on economic policy, there is a need for systematic monitoring and analysis of market stability taking the following measures: establishment of a regional center for food security monitoring for European countries and the CIS; cooperation with the countries of Europe and the CIS in the field of marketing and trade, maintaining transparency of information, food security governance, improvement of market infrastructure;
 - stepping up integration within Europe and the CIS by harmonizing trade rules and creating opportunities for implementation of bilateral and multilateral agreements;
 - raising public awareness of the agricultural and food trade situation by making forecasts and maintaining a dialogue at all levels (local, national, regional and global ones) with the involvement of governmental institutions, civil society institutions and the country's intellectual potential;
 - participation in improvement of the humanitarian aid system in terms of food security through global and regional coordination and investment in risk prevention systems, as well as in derisking funds (e.g. insurance, public funds) with the prospect of creating an appropriate European and CIS center (Chaves et al., 2015; Kornienko et al., 2015; Herzfeld et al., 2017; Jambor & Babu, 2017; Bryzhko et al., 2018; Markina et al., 2018a).
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7. Conclusion

It is found out that general indicators that characterize the level of food security of the country are the Global Food Security Index and the Global Hunger Index. At the same time, using the example of Ukraine, the paradox of these indicators has been determined, as the decrease in the Global Food Security Index results in a decrease in the level of hunger in the country.

Characteristics of the most common methods of assessing the level of food security, systems of calculation of its level has allowed us to form our system of indicators of food security on the basis of the Global Food Security Index and the Global Hunger Index, distinguishing features of which are its complexity and flexibility. The practicability of the proposed system of indicators of the food security level of the country is substantiated by the possibility of reducing the measurement of indicators to the range of values of each indicator from 0 to 100. The proposed set of food security indicators and criteria can be transformed, additional criteria and assessment indicators can be introduced depending on the agricultural focus of the country and development of its agricultural production. The system of indicators makes it possible to carry out food security analysis rather quickly, and the results of the assessment can be used by authorities in planning and developing agri-food policy measures. The developed system is quite laconic but at the same time informative.

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