

CORRELATION OF SUSTAINABLE DEVELOPMENT AND FOOD SAFETY INDICATORS

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Abstract: *Following the successive events that have taken place in the global arena in terms of economic growth and its consequences, there has been a need to assess the consequences of all the changes that have taken place. The indicators of sustainable development and food security indicators help us to assess the current state of world development. Through the indicators of sustainable development, we can clearly identify the situation with regard to the three development approaches: economic approach, ecological approach and social approach.*

Key words: *Deep poverty index, Food consumption score, Food Diversity Rate, Share of the poorest quintile in national consumption, Share of the population below the minimum food consumption, expressed in energy value (2 282 kcal / day) (extreme poverty rate).*

JEL Classification: *D1, E21, I32.*

1. General information

Following the successive events that have taken place in the global arena in terms of economic growth and its consequences, there has appeared a need to assess the consequences of all the changes that have taken place. The indicators of sustainable development and food security indicators help us to assess the current state of world development. Further, the author will show what is the correlation between these indicators and what can we measure with their help.

Through the indicators of sustainable development, we can clearly identify the situation with regard to the three development approaches: economic approach, ecological approach and social approach.

The reflection of sustainable development indicators includes the solution of several issues that arise over the last period of time, depending on the approaches discussed, and namely:

- The complexity of the social approach estimation: the different significance of the social dimension at international level, the difficulty in measuring the social capital in a particular country, region;
- The reception of the multinational contingent: By analyzing the indicators we can not hide such conditions as pollution, floods, and various natural disasters that penetrate the frontiers.

Regarding data collection and processing are considered the following assessments:

- a. Availability of current issues;
- b. Data processing achievement level;
- c. The methods applied in calculating data related to sustainable development.

The main analytical aspects indicating the level of sustainable development indicators are (United Nations, 2007):

- a. Poverty;
- b. Government;
- c. Health;
- d. Education;
- e. Demography;
- f. Natural risks;
- g. Atmosphere;
- h. Lands;

- i. Seas and oceans;
- j. Fresh water;
- k. Biodiversity;
- l. Economic development;
- m. World Economic Association;
- n. Consumption and production patterns.

From all the analyzed aspects, we will only analyze those that have a direct influence on the measurement of ensuring food security.

We will continue to address the level of sustainable development through the indicators of realency of the analyzed issues.

a. The aspect of poverty. For the calculation of this aspect we will identify the following indicators (Biroul Național de Statistică, 2018):

Poverty Depth Index (Pa) - which represents the average consumption of the population in relation to the poverty line. This indicator shows what allowance must raise the incomes of all the poor, up to the poverty line. This indicator is calculated based on the formula:

$$P_a = (1/n) \sum_{i=1}^q \left(\frac{L - C_i}{L} \right)^\alpha \quad (1)$$

where:

Pa - the depth of poverty index (for the depth of poverty $\alpha = 1$);

L - the poverty line;

C - average consumption expenditure per adult equivalent;

i - individual persons;

n - total number of persons;

q - the number of people with average consumption expenditure per adult equivalent less than the poverty line.

Population share under the absolute poverty line (Rsa) - the number of households in households with monthly costs per adult equivalent less than the absolute poverty line, expressed as a percentage of the total population. The absolute poverty line represents the amount of food costs that provides a consumption of 2282 kcal / person / day, adjusted to the structure of food consumption of households in deciles 2-4, plus non-food costs established on the basis of the average household costs.

$$Rsa = \frac{n_s}{N_{tot}} * 100\% \quad (2)$$

where:

Rsa – poor population ratio / absolute poverty rate;

ns - the number of people with average monthly costs per adult equivalent less than the absolute poverty limit in the reference period;

Ntot - the total annual average of the current population in the reference year.

The poorest quintile share in national consumption (Ps) - Volume of consumption / costs for households in quintile I (20% of the poorest households) in relation to the total consumption / expenditure of all households in the country. It is unilateral to inequality and shows how the population's consumption is lower than the average quintile (consumption of the whole population). Population distribution on quintiles is made after consumption / spending per person, separately for each population group.

$$P_s = \frac{V_s}{V_{tot}} * 100\% \quad (3)$$

where:

P_s - the share of the poorest quintile in national consumption;

V_s - the volume of consumption / costs for quintile I households (20% of the poorest households) in the reference year

V_{tot} - the total consumption / costs volume of all households in the country in the reference year.

The population share below the minimum energy consumption (2 282 kcal / day) (extreme poverty rate) (Rse) - The number of households in households with monthly costs per adult, lower than the extreme poverty line, relative to the total population, expressed in percentage. The extreme poverty line represents the amount of food costs that ensures a consumption of 2282 kcal / person / day, adjusted to the structure of food consumption of households in deciles 2-4.

$$Rse = \frac{n_s}{N_{tot}} * 100\% \quad (4)$$

where:

Rse - the population share below the minimum food consumption, expressed in energy (2 282 kcal / day) (extreme poverty rate);

n_s - the number of population with average monthly costs per adult equivalent below the extreme poverty limit in the reference period;

N_{tot} - the total annual average of the current population in the reference year.

b. **Natural risks** take into account the population living in areas prone to threats obtained from natural conditions;

c. **Land**s shall calculate such indicators as the area of the arable land under cultivation and the proportion of land covered by forests;

d. **Freshwater**: the rate and ratio of total water resources used, the intensity of water use according to economic activity;

e. **Biodiversity**: the ratio of the total protected terrestrial area by the ecological region; changes that come from external threats regarding crop and plant species.

f. **Economic development**: GDP evolution per capita, GDP investment quota, labor productivity and disposable income of the labor force.

2. Discussion of the experimental study

Through the indicators, we can analyze different situations regardless of the applicable level and which are difficult to quantify directly. We can not assert with certainty that an indicator is better and the other is worse, or an indicator reflects a more effective analysis and the other does not. All indicators reflect the real level of the created situations, everything depends on what we want to find out through one indicator or another. The more complex the studied phenomenon is, the greater the need to apply a stunning set of indicators, as the level of food security and sustainable development can not be measured by a single indicator. So it appears that for the food security analysis we have to group together a series of indicators that reflect what the real situation is. However,

by performing the grouping of indicators, we need to consider that the pooled indicators are justified and have a direct correlation.

Based on the conditions created by radical changes in the third millennium, there are a number of indicators through which we can reflect on ensuring food security at any desired level: world, national, regional, local, individual. What we can show through Figure 1.

Food safety measurement indicators that are included regardless of the level under consideration are delimited in several ways: demographic; the disposable income of the population; the level of available assets; the costs incurred; food consumption; access to drinking water and sewage systems; health.

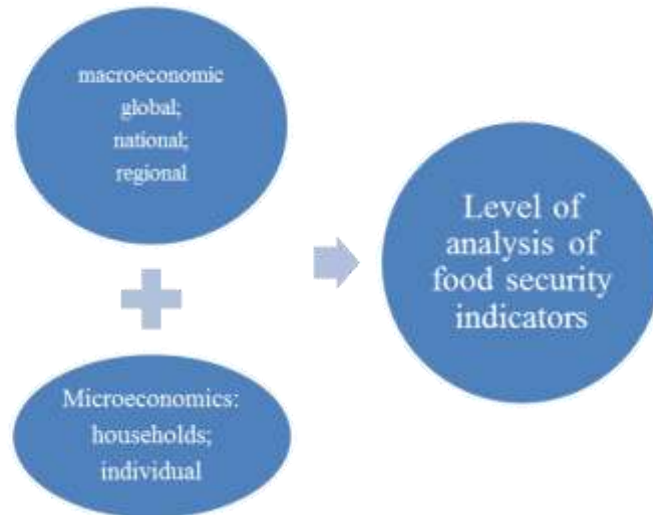


Figure 1. Level of analysis of food security indicators

Source: elaborated by the author

As a result of the situation created in the Republic of Moldova regarding food security (2007-2008 crisis, natural calamities, political crisis), we will only consider those indicators that have a direct influence on food security and which are reflected in the literature of that domain.

On the basis of the analyzed literature, we have several classifications of indicators of food security at individual level and households that are in turn grouped according to several criteria. We will also combine these indicators (Maxwell, Coates and Vaitla, 2013):

Diversity and frequency of food: the result of this indicator reveals the diversity of food consumed by the population, but not the quantity, but in the last period of time, the relationship between diversity and the caloric value of the products consumed has also been demonstrated by stringent debates;

Diversity and frequency of foods include indicators such as: food consumption score (FCS), food diversity rate; food consumption, the subsistence minimum.

FCS takes into account the consumption frequency of one or more food products. The main food groups to be assigned to FCS are: cereals, beans, meat, milk and dairy products, vegetables, fruits, oils, fats, sugar.

Households are grouped into three large groups according to the results obtained from the FCS calculation: food insecurity, marginal food security and food security. The level of delimitation of these three groups is based on the Weighted Consumption Food Score (Table 1).

Table 1. Food consumption thresholds

Group of food consumption	Standard limit	Limits adjusted with oil and sugar consumed daily
Poor food consumption	0-21	0-28
Food consumption at the limit	21-35	28-42
Acceptable food consumption	>35	> 42

Source: World Food Programme, 2015. *Food security assessment report. Executive summary, Syria, October 2015, Data collected May – June 2015*, p.17.

The weighted score of consumed food is calculated as the product of the nutritional density that is assigned to each group of foods consumed in the number of days. Figure 2 shows the food security delineation of weighted food weights.

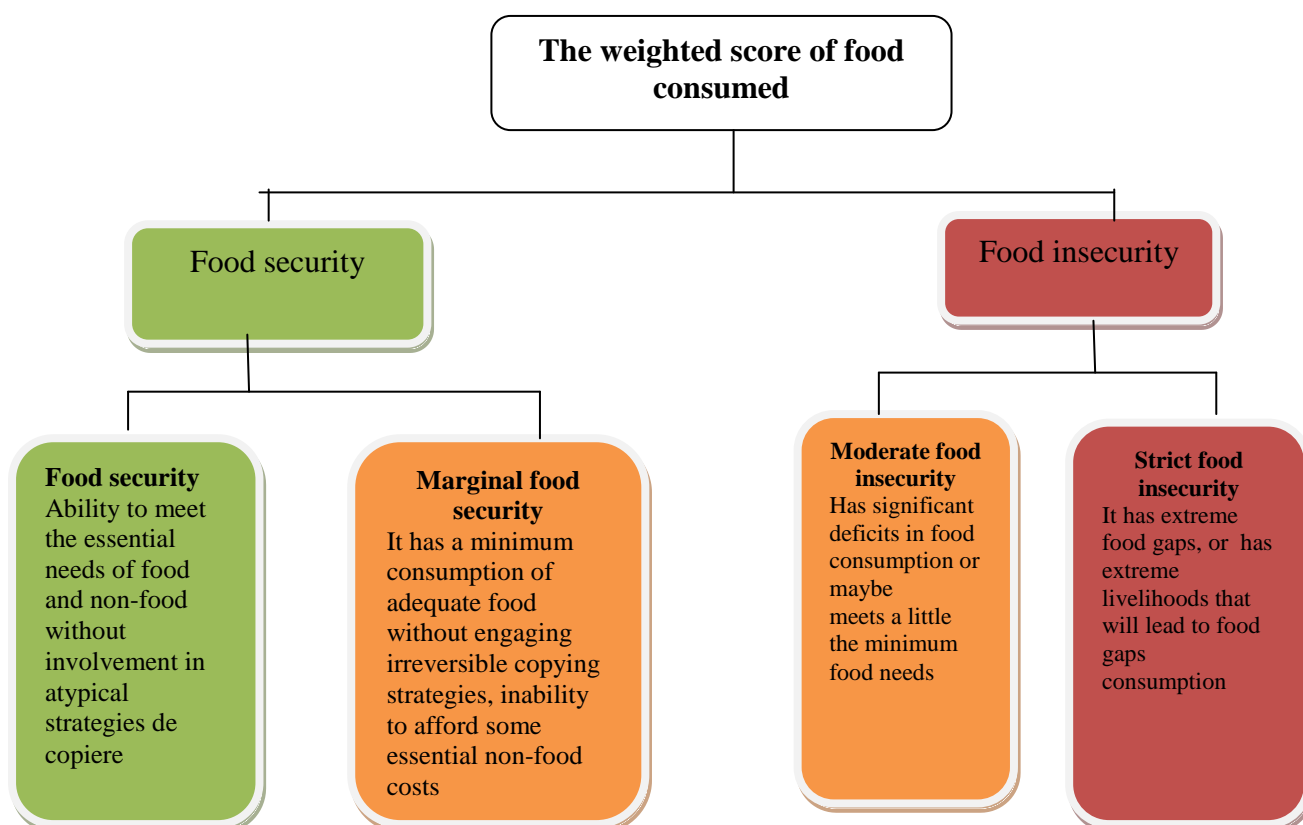


Figure 2. Delineation of food security according to the weighted score of consumed food

Source:elaborated by the author

Each household is given a weight that is derived from the total score of foods consumed (Table 2) which is calculated weekly: the minimum is "0" and maximum "112". But to see dynamically what is the total food score at national level, it is calculated annually.

Table 2. Food groups and assigned weight

Food product indicator	Food Group	Share
Corn, wheat, porridge, rice, millet pasta, bread and other cereals.	Cereals	2
Potatoes and sweet potatoes		
Beans, peas, peanuts	Beans	3
Vegetables	Vegetables	1
Fruits	Fruits	1
Beef, goat, bird, eggs and fish	Meat and fish	4
Milk and dairy products	Milk	4
Sugar and sugar products	Sugar	0,5
Oils, fat and butter	Oil	0,5

Source: World Food Programme, 2015. *Food security assessment report. Executive summary, Syria, October 2015, Data collected May – June 2015, p.17.*

From the data presented in Table 2 we note that according to the physiological norms and the level of protein that a weekly person has to consume, the highest share of "4" belongs to the categories "Meat and Fish" and "Milk". Second place is "Beans" with "3" opens, and third place "Cereals" with a weight of "2".

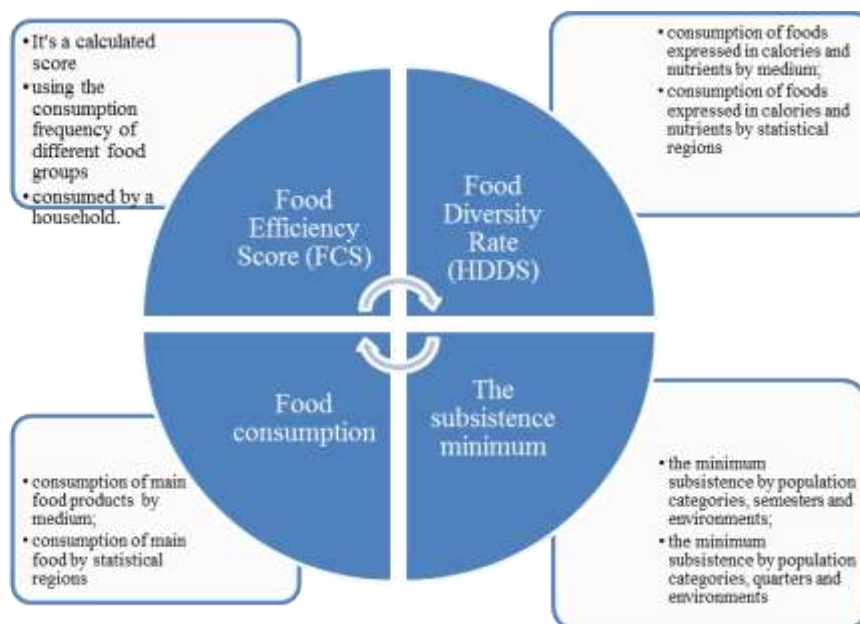


Figure 3. Structure of the indicator "Food Diversity and Frequency"

Source: elaborated by the author

Food availability: This indicator reflects the behavior of people during food consumption. Here are analyzed such indicators as disposable income and consumer s' spendings on food. Figure 4 shows the "Food availability" indicators and what are the measurement formats.

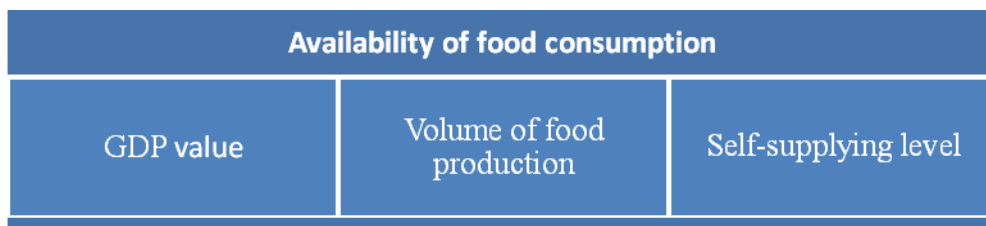


Figure 4. Indicators "Availability of food consumption"

Source: elaborated by author

As mentioned earlier, scholars and researchers in the field have a growing concern to group and analyze food security indicators. Along with them, there are also world-class organizations such as FAO, UN, UNICEF and others whose tasks are both static and dynamic analysis of these indicators.

Each of the indicators analyzed so far overlaps with Agenda 2030 ODDs: "Zero Famine", "No Poverty", "Clean Water and Sanitation".



Figure 5. Macroeconomic indicators for food security measurement

Source: elaborated by author

But let us not forget that each indicator, no matter what its analysed level is, should not be considered the same for each country, because there are several circumstances that may affect the level of one or other of the indicators such as geographical location, demographic situation, political situation etc. Yes, it is certain that every country, regardless of the situations or threats it has in terms of food security, it must tend to make it more efficient. Macroeconomic indicators of food security we will also combine into one category. In the category of macroeconomic indicators that directly affect the level of food security we included: the indices of the agricultural production prices, the volume of water distributed to the territorial consumers, water supply systems in the territorial profile, the depth of poverty index, the consumer price index of food products; agricultural land, food production volume, import value of food. Figure 5 shows food security indicators at macroeconomic level. With the elaboration and approval of food security policies, there

was also the need to analyze food security indicators according to specific dimensions: availability, access, use and stability. Next, we will group all the microeconomic and macroeconomic indicators of food security according to the dimensions.

Table 3. Grouping food security indicators according to size

Dimensions of food security			
Availability	Access	Use	Stability
Food consumption score	Average prices and sales indices	The volume of water distributed to consumers in the territorial profile	GDP per capita
Food Diversity Rate	Prices and indices of sales of agricultural production	Water supply systems in territorial aspect	Value of food imports
Food consumption	Sources of food insurance: Urban or rural	Malnutrition level depending on the territorial aspect	Food price index of foodstuffs
The subsistence minimum	Investment level for farmers		Volume of food production
Available household income			Land with agricultural use
Household costs			Lands of the water fund

Source: elaborated by the author

Combining all these indicators is the most important indicator of food security proposed by FAO: the Global Food Security Index (GFSI). This indicator is designed to measure food security for 169 countries regardless their economic development level. Through this indicator, we can identify the gaps in ensuring food security in a country.



Figure 6. Global Food Security Index

Source: elaborated by the author

To a large extent, the Global Food Security Index covers risks for all levels and dimensions. But let us not forget that this indicator cannot take into account such phenomena as the risks related to food security, which the author has analyzed in the second chapter of this research.

The Consolidated Approach to Food Safety Reporting Indicators (World Food Programme, 2015, p.14) is a method through which we can measure the level of security in a particular country. To implement this method, it is necessary to use the food security indicators that we have previously analyzed. The following groups are taken into account in the Food Safety Reporting Matrix: the food consumption rate, the level of poverty existing in the country and the existing living strategies. Also, the size of the hood reached: food security and food insecurity.

Table 4 presents the Consolidated Approach for Food Safety Reporting Indicators. Each of the analyzed domains is characterized by dimensions, such as the current level of the indicators analyzed and the existing capacity.

The "current indicator level" dimension itself includes indicators that measure the level of households receiving food consumption. The "existing capacity" dimension includes indicators that measure the economic vulnerability of households.

Table 4. Consolidated approach to Food Safety Reporting Indicators

	Dimensions	Indicators	Food security		Food insecurity	
			Food security	Marginal security	Moderate food insecurity	Strict food insecurity
Current indicator level	Food consumption	Food consumption group	Acceptable ≥ 42	-	Limit $28 \leq 42$	Poverty $0 \leq 28$
Existing capacity	Economic vulnerability	Poverty level	Total costs > The poverty line 100%	-	Poverty limit $100\% > 100\%$ of the food poverty line	Total exp < 100% din pragul sărăciei alimentare
	Exhaustion of assets	Categories of living strategies	None	Employee stress strategies	Crisis strategies for employees	Crisis strategies for employees

Source: World Food Programme, 2015. *Food security assessment report. Executive summary, Syria, October 2015, Data collected May – June 2015*, p.17.

For the assessment of food security at the level of international organizations, we can apply the indicators proposed in the EurAsEC Food Security Concept (Eurasian Economic Commission, 2018) and in the Concept of Food Security Improvement of the CIS Member States (E-cis Info, 2018).

According to the Food Security Concept of the Eurasian Economic Community, which was approved on December 11, 2009, the main indicators of food security influence are (Eurasian Economic Commission, 2018):

1. The size of the State Food Reserve, which includes the irreducible supply of food products, intended to prevent a food crisis or eliminate its consequences;
2. the volume of the capacity of the internal market for individual foods, defined as the annual per capita consumption of a given food by the average annual population;
3. The biological safety indicator, which includes the harmful substances content in 1 gram of food;
4. Energy value (kcal), protein (mg), fat (mg), carbohydrate (mg);
5. The degree of satisfaction of the daily energy demand for a person
6. The ratio between real food consumption, taking into account its food and energy value at the normative values;
7. The normative values of food value and food energy, established by the competent body of each EurASEC Member State;
8. The rational food consumption rules established by the relevant body of each EurASEC Member State;
9. Sufficient level of consumption of a separate foodstuff;
10. The ratio between real consumption and rational rate;
11. The level of basic food stocks in state reserves
12. The ratio between actual stock levels and annual consumption;
13. Level of food independence for individual foods;

14. The ratio between the value of a specific foodstuff's own production and that of the internal market of that product;

15. The level of economic accessibility of food - the ratio of food costs to total costs for all types of goods and services;

16. Daily nutritional value obtained from eating food products for one person;

17. Daily energy value obtained from the consumption of food products per person;

18. Sufficient stock of grain stocks in national resources;

19. Sufficient supply of pure drinking water;

20. The level of current, strategic and transferable stocks in relation to their regulatory levels;

21. The degree of satisfaction of the physiological needs of foods, taking into account their nutritional and energy value.

In the concept of enhancing food security of the CIS Member States, approved by the CIS Council of State Council Decision of November 19, 2010, a set of principles are established on which the level of food security can be assessed (E-cis Info, 2018):

1. The level of economic accessibility of food products - the ratio of food costs to total costs for all types of goods and services;

2. The potential capacity of the internal market for individual food - the product of a rational consumption of a given food product per capita to the average annual population;

3. The level of food self-sufficiency for food products - the ratio between the production volume of a specific food product and the real consumption of the product;

4. The biological quality indicator - nutrient value and vital energy content in 1 gram of food: energy (kcal), protein (mg), fat (mg), carbohydrate (mg);

5. The biological safety indicator - is determined by the content of harmful ingredients in the food, which does not exceed the admissible level (regulatory);

6. Daily nutrition and energy consumption of food for one person;

7. The level of enough calories obtained from the consumption of each food;

8. Sufficient level of grain stocks in national resources;

9. Sufficient supply of pure drinking water;

10. Physical accessibility of food for different categories of population;

11. Degree of dependence on food insurance and resource maintenance of the agro-food complex towards imports;

13. The degree of satisfaction of the physiological needs of foods, taking into account their nutritional and energy value.

As we can see, many of the indicators stipulated in both concepts are repeated. In order to assess the extent to which food security is achieved, the indicator - the proportion of agricultural and fishery products, raw materials and food products in the total volume of goods resources in the domestic market, expressed as a percentage, is used. The limit values of this medium-term criterion for CIS Member States may be recommended in Table 5.

Table 5. Recommended limits for the main types of food in the CIS countries

The name of the product	Recommended limits for main types of food,%
Cereals	95
Milk and dairy products (from the milk point of view)	90
Meat and meat products (from the point of view of meat)	85
Fish products	80
Sugar	80
Vegetal oil	80

In the Concept of Improving Food Security of the CIS Member States, the following conclusion is drawn on the principles of food security of the CIS Member States "Ensuring food security of the CIS participating states requires the substantiation of the internal production of the necessary food resources and the abstraction of drinking water in appropriate quantities with the dimensions of the main types of food consumption, using the feed system of the rules underlying the calculation of the minimum subsistence, on scientific basis physiological norms and rational consumption of food power supply. This regulatory framework is necessary to determine the limit of food consumption as the most important features of a healthy way of life of the population of states - CIS participants.

3. Conclusions

Food security indicators and Sustainable Development Indicators are very tight, even with some overlaps. The calculation of these indicators allows us to highlight the dynamic situation regarding food security at country level. The level of food security of each country shows us the most impressive result that a nation can have or other, namely, the health of the population . If a fairly high level of security is recorded, then it is obvious that the country's population has physical and economic access to agricultural resources and products according to vital needs. We recommend to the Republic of Moldova the elaboration of a database in which the results of the food safety indicators will be reflected in order to identify as quickly as possible the situation created and the possibility of neutralizing the threats received both from the exogenous and endogenous factors of the country.

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