ORIGINAL ARTICLE

Statistic evaluation of food security of Russia

Tatyana G. Khramtsova[1], Bibigul A. Amanzolova[2], Lidiya P. Nagovitsina[3]

[1]Department of Economics and Management, Novosibirsk State Pedagogical University, Novosibirsk, 630126, Russia, [2]Department of Accounting and Statistics, Faculty of Business, Novosibirsk State Technical University, Novosibirsk, 630073, Russia, [3]Department of Economics, Siberian University of Consumer Cooperation, Novosibirsk, 630073, Russia

Abstract

Aim: The aim of article is to presents one of aspects of food security: Provision of accessibility of food products for the population. **Materials and Methods:** Carrying out of analysis of dynamics of production of major agricultural products, giving an assessment of extent to which norms of rational consumption and availability of products for the population; simulation of indexes of production and volume of private consumption of certain foods has been carried out. **Result:** Revealing of certain problems in the sphere of provision of economic and physical availability of food products for the population of the country. Representing regional approach to assessment of problem of provision of food security. **Conclusion:** Offering to use indexes of localization of agricultural indications is done for assessment of food security which allowed to make assessments about regional differentiation of food security level.

Key words: Agricultural production, balance of food resources, food availability, food consumption, food security, localization indexes, rational consumption rate, regional differentiation

INTRODUCTION

The problem of food security has acquired global dimension since 70s of the previous century as a result of a conflict formed up between absolute overproduction of food in developed countries and mass malnutrition of the population in some developing countries. To generate and implement the strategy in the area of food security, an intergovernmental body has been established in 1974 – the Committee on World Food Security. The result of activation of international society's attention to the problem of food security of the population was the Rome Declaration on World Food Security adopted at the World Summit Meeting on Food Security in 1996.

In the 1990s, a real threat of food dependence appeared in Russia bringing the problem to the national level. As part of its solution, the development of relevant concepts which found its expression in the form of the Food Security Doctrine of the Russian Federation approved by the Decree of the President of the Russian Federation in 2010, is required. Deterioration of political and economic situation in 2014 brought a further exacerbation of food security problems of Russia associated with reduction of deliveries of the most important food commodities to the Russian market due to food embargoes from Russia in response to economic sanctions of the West.

According to the Doctrine, "food security is a state of the Russian economy which provides food independence," guaranteed by physical and economic access of the population to food products meeting requirements of technical regulations in quantities no less than rational consumption norms required for an active, healthy life.[1]" The main aspects of evaluation of food security are: First, physical availability of food; second, economic accessibility of food; third, ecological safety of food for the population.

MATERIALS AND METHODS

Economic and physical accessibility of food means that the income level of the population at the current level of prices

Address for correspondence:
Tatyana G. Khramtsova, Department of Economics and Management, Novosibirsk State Pedagogical University, 28, Viluiskayast., Novosibirsk, 630126, Russia.
E-mail: tanyhram@mail.ru

Received: 27-06-2017
Revised: 20-07-2017
Accepted: 29-07-2017

provides an opportunity for the population to purchase basic products in a volume and range not lower than one established by rational consumption norms necessary to ensure health and active lifestyle of Russians. Nutrition is one of the most important factors determining health of the nation. Full nutrition ensures normal growth and development of children, contributes to prevention of diseases, increases capacity for work of a person, and increases life expectancy. Insufficient consumption of micro nutrients, proteins, and vitamins contained in food, their irrational balance lead to health deterioration of the population, to decrease of human potential.[2]

RESULT AND DISCUSSION

To ensure physical availability of food, the Russian government initiated measures to protect and subsidize the agricultural production aimed at investment support for agriculture, and they provided results. Due to attraction of solid investments and basing on diversification, Agro holdings of regional and interregional level have been formed. Positive structural shifts occurred in production of most important types of agricultural products, which consist in increase of share of agricultural organizations in total production [Table 1].

In 2010-2014, the share of agricultural products increased by 5% and approached half of all production. Advantages of large-scale agricultural production made it possible to achieve a fairly stable increase of agricultural production [Table 2].[3,4]

Table 1: Russian agricultural production structure on farm categories for 2000-2014 (%)

Farm categories	2000	2010	2014
Farms of all categories	100	100	100
including			
Agricultural organizations	45.2	44.5	49.5
Farms of population	51.6	48.3	40.5
Peasant (farm) households	3.2	7.2	10.0

For 2000-2014, production of livestock and poultry for slaughter (slaughter weight) in Russia increased 2-fold, including poultry – 5.4-fold. Growth in egg production was 122.8%. Gross harvest of cereals and leguminous crops has been managed to increase from 65 to 105 million tons or for more than 60%. If we consider the past 5 years from 2010 to 2014, growth in poultry meat production is worth estimation by 46.2%, pork by 27.6%, cereals by 72.8%, and vegetables by 27.2%. Dynamic development of poultry farming attracts attention, thanks to which it can be stated that market is saturated with both poultry meat and eggs as well. A significant increase in grain harvesting during this period is due to the fact that comparison was carried out since 2010, the characteristic feature of which were unfavorable climatic conditions that caused a significant reduction in the grain yield.

Economic availability of food depends on the level of income of the population and the prices of food.

In 2010-2014, monetary incomes of the Russian population increased by 34.2%, including labor compensation by 39.1%, social payments by 39.6%, and income from entrepreneurial activity by 20%. An important indicator of positive trends in quality of life of the population is reduction of the share of food expenditures in the structure of household expenditures: From 47% in 2000 to 28% in 2010 and 27% in 2014.[3,4]

The growth of incomes of the population and production of most important types of agricultural products contributed to certain improvement in consumption of food by the population. In 2010-2014, consumption of most food products, including those that are most valuable in nutritional terms, increased. Growth rates of per capita consumption in Russia were as follows: Fruits and berries 110.3%, vegetables 109.9%, meat and meat products 107.2%, and

Table 2: Production of agricultural goods (in farms of all categories) in Russia for 1990-2014

Indexes	1990	2000	2010	2014	2014 in percent to		
					1990	2000	2010
Cattle and poultry for slaughter (slaughter weight), thousand tons	10111.6	4445.8	7166.8	9070.3	89.7	204.0	126.6
Including							
Cattle	4329.3	1897.9	1727.3	1654.1	38.2	87.2	95.8
Pigs	3480.0	1578.2	2330.8	2973.9	85.5	188.4	127.6
Poultry	1801.0	767.5	2846.8	4161.4	231.1	542.2	146.2
Number of cattle, thousand heads	57043	27519.8	19967.9	19374.5	34.0	70.4	97.0
Milk, thousand tons	55715.3	32259.0	31847.3	30790.9	55.3	95.4	96.7
Eggs, million pieces	47469.7	34084.7	40599.2	41860.0	88.2	122.8	103.1
Grain and leguminous crops, thousand tons	116676	65420	60960	105315	90.3	161.0	172.8
Sown area, thousand hectares	117705	84670	75188	78525	66.7	92.7	104.4

vegetable oils 103%. A positive assessment is in decrease per capita in consumption of bread products by 2%, a slight increase in sugar consumption (102.6%). At the same time, one should note the presence of such a negative phenomenon as reduction in consumption of milk and dairy products by 1.2% [Table 3].

To assess the degree of satisfaction of the need for food as a reference or standard base, rational consumption norms are used, approved by order of the Ministry of Health and Social Development of the Russian Federation dated August 2, 2010, No. 593n.

For 2010-2014, the compliance of actual consumption of meat and meat products with rational standard has been achieved. At a rational norm of consumption of meat and meat products at the level of 70-75 kg per year per capita, the actual consumption increased from 69 kg in 2010 to 74 kg in 2014 [Table 4].

The growth rate of consumption of vegetables and fruits was insufficient for the achievement of rational norms. Underconsumption of vegetables by Russians ranged from 22% in 2010 to 15% in 2014. More significantly looks underconsumption of fruit: In 2010, the rational norm was satisfied only by 61%, in 2014 – by 67%. The population receives significantly less vitamins contained in vegetables, gourds, fruits, and berries. If the current trend of consumption of vegetables and fruits per capita continues to increase, a rational norm of consumption of vegetables will be reached only after 8 years, fruits – in 19 years.

However, if there is at least a consistent tendency of degree increase in achievement of rational norm of marked products, then underconsumption of milk and dairy products looks really catastrophic. During the analyzed period, the degree of satisfaction of physiological needs in dairy products remained almost at the same level – 75%.

Estimation of dynamics of consumption of certain food products by the population for a longer retrospective confirms the existence of a stable trend.

The increasing consumption of meat and meat products, vegetables and melons, fruit and berries, vegetable oil and decreasing consumption of bread and bread products are both quite stable. At the same time, figures for 2014 demonstrate negative consequences of introduction of sanctions, a fall of ruble exchange rate, an unfavorable macroeconomic situation this year which could not but affect consumption of food. There is a negative deviation of actual consumption from the trend.

The solution of the problem of ensuring food security on the most important food products to a large extent depends on the increase in domestic production of goods.

Table 3: Consumption of food products per capita in Russia for 2010-2014

Product title	2010	2014	Increase tempo (%)
Potatoes, kg	104	111	106,7
Seed oil, kg	13.4	13,8	103,0
Milk and dairy products, kg	247	244	98,8
Meat and meat products, kg	69	74	107,2
Vegetables and gourds, kg	101	111	109,9
Sugar, kg	39	40	102,6
Fruits and berries, kg	58	64	110,3
Bread products, kg	120	118	98,3
Eggs and egg products, ps.	269	269	100,0

Table 4: Degree of satisfaction of rational consumption norms of the population of Russia for 2010-2014 (%)

Product title	2010	2011	2012	2013	2014
Potatoes	107	113	114	114	114
Seed oil	122	123	125	125	125
Milk and dairy products	75	75	75	75	74
Meat and meat products	95	98	102	103	102
Vegetables and gourds	78	82	84	84	85
Sugar	150	154	154	154	154
Fruits and berries	61	63	64	67	67
Bread products	120	119	119	118	118
Eggs and egg products	103	104	106	103	103

Analysis of food supply balance shows that there has been a positive trend in increase of production of meat and meat products, vegetables, and melons. In 2010-2014, their production increased by average of 6% annually. Increase of meat production outpaced the growth of personal consumption 1.15-fold [Table 5].

Measures taken by government in the framework of implementation of the Doctrine of Food Security have given their results: The share of production of meat and meat products in resources of this product increased totally from 71% in 2010 to 82% in 2014 [Table 6]. The volume of imports has significantly decreased: From 2855 thousand tons in 2010-1952 thousand tons in 2014, or by 31.6%.

For 2010-2014, there was a stable tendency on increase of meat production well approximated by the trend model:

$$Y_t = 6629.1 + 483.1t.$$

Table 5: Food resources in Russia in 2010-2014, thousand tons

Year	Meat and meat products		Milk and dairy products		Vegetables and gourds		Fruits and berries	
	Production	Imports	Production	Imports	Production	Imports	Production	Imports
2010	7167	2855	31847	8159	13278	3158	2474	6780
2011	7520	2707	31646	7938	16270	3155	2927	6971
2012	8090	2710	31756	8516	16079	2806	2931	7084
2013	8545	2480	30529	9445	16109	2817	3380	7201
2014	9070	1952	30791	9155	16885	2929	3525	6680
2014 in % to 2010	126.6	68.4	96.7	112.2	127.2	97.2	142.5	98.5

Table 6: Structure of food resources in Russia in 2010-2014 (%)

Year	Meat and meat products		Milk and dairy products		Vegetables and gourds		Fruits and berries	
	Production	Imports	Production	Imports	Production	Imports	Production	Imports
2010	71.5	28.5	79.6	20.4	80.8	19.2	26.7	73.3
2011	73.5	26.5	79.9	20.1	83.8	16.2	29.6	70.4
2012	74.9	25.1	78.8	21.2	85.1	14.9	29.3	70.7
2013	77.5	22.5	76.4	23.6	85.1	14.9	31.9	68.1
2014	82.3	17.7	77.1	22.9	85.2	14.8	34.5	65.5

Provided that the current trend is maintained the predicted production of meat will amount to 9,527,700 tons in 2015 and 10,010,800 tons in 2016 what is a reliable basis for satisfying personal consumption in short term. The dynamic regression model of dependence of the volume of personal consumption of meat (Y_x) on its production in the country (X) has the form as:

$$Y_x = 5925.3 + 0.56X.$$

Regression analysis showed that under increase in meat production per 1 thousand tons, the volume of personal consumption increases by 0.56 thousand tons. The determination rate indicates that 94.8% of volatility of the volume of personal meat consumption is due to variation in its production.

Based on dependence of the volume of personal meat consumption on its production, the forecast of the indicator was obtained: As follows: In 2015, the volume of personal consumption should reach 11260.8 thousand tons and grow by 3.5% as compared to 2014; in 2016 – 11531.3 thousand tons and grow by 6% compared to 2014.

Prediction of the volume of personal meat consumption performed on the trend model of the index ($Y_t = 9628.7 + 271.3t$), slightly differs from prediction for the regression model [Table 7].

Taking into account that the growth rate of the population of the Russian Federation lags behind the predicted growth rate

Table 7: Prediction of the volume of personal consumption of meat and meat products in Russia for 2015-2016, thousand tons

Prediction model	2015	2016
Regression model of dependence of personal consumption on meat production in the country	11260	11531
Trend model of personal consumption amount	11257	11528

of personal consumption, it can be argued that in the near future there will be further increase in consumption of meat and meat products per capita. In 2015, the growth rate of the country's population was 100.2%. The predicted index of per capita consumption (I_c) is calculated through the predicted growth of total volume of personal consumption (I_t) and the current population growth (I_p):

$$I_c = I_t : I_p.$$

In 2015, the increase in consumption of meat and meat products per capita will be 103.3%, in 2016-105.6% compared to 2014.

In addition, relatively favorable look tendencies of formation of vegetable resources [Tables 5 and 6]. The production of vegetables for the period under review has increased by 27.2%. The amount of imports decreased by 7.3%. As a result, the share of imports in the total volume of vegetable resources decreased from 19.2% in 2010 to 14.8% in 2014.

However, as noted earlier, such rates of increase in production are insufficient to achieve rational norms for consumption of vegetables. Increasing production of vegetables raises the problem of organizing their storage and formation of commodity stocks.

Mirror opposite structure is characterized by resources of fruits and berries. In 2014, domestic production of fruits occupied slightly more than one third, while imports accounted for 65.5%. Fruit production has developed quite dynamically increasing averagely by 9.3% annually and increased by 42.5% in 2014 compared to 2010. This allowed to increase availability of resources by own production from 26.7% in 2010 to 34.5% in 2014. Introduction of sanctions significantly affected the reduction of imports of fruits and berries in 2014 by 7.2% compared to the previous year. If you take into account climatic features of geographical location of the country, it is easy to assume that under consumption of this product by Russians will be chronic even if new suppliers are successfully found.

The situation arisen with provision of milk and dairy products looks extremely unfavorable. In 2010-2014, milk production in the country decreased by 3.3%, while import of dairy products increased by 12.2%. As a result, availability of resources of this product due to own production decreased by 2.5 percentage points, and dependence on imports increased from 20.4% in 2010 to 22.9% in 2014.

Decline in milk production was the result, first of all, of reduction of a number of cattle.

Reduction in the number of cattle, including the dairy herd, has assumed a sustained lingering character. If it has decreased by 3% over the past 5 years, then – by almost 30% for the period from 2000 to 2014: From 27.5 to 19.4 million animals. Over the period from 1990 to 2014, the number of livestock decreased almost threefold.[5]

Reduction of the number of cattle affected the species structure of production and, as a consequence, consumption of meat. In accordance with the Food Security Doctrine, the share of beef in total meat production should make 33%. In 2010-2014, the agricultural sector was not able to approach this standard. In 2014, the share of beef was only 18.2% and decreased by 5.9% points compared to 2010. Specific weight of poultry meat has increased significantly: From 39.7% to 45.9%. Such structural shifts were the result of multi directional production dynamics of certain types of meat products. If during the analyzed period production of livestock and poultry for slaughter (in slaughter weight) increased by 26.6%, then poultry production did by 46.2%, pigs, sheep, and goats – by 25.5%, and beef production decreased by 4.2% [Table 8].

The tendency to increase production of meat, to achieve a rational rate of consumption of meat and meat products has been influenced by dynamic development of poultry and increase in production of poultry meat. Although a quantitatively rational rate of meat consumption has been achieved, the structure of consumption needs to be improved.

The concept of ensuring food security should include a regional dimension. If we want to achieve physical accessibility of ecologically safe products for the population, it would be most expedient to bring production of such important food products as meat and meat products, milk and dairy products closer to places where people live. The geography of production of meat and dairy products should gravitate toward deployment of the population. An extensive factor in increasing production of these types of food is the number of cattle.

The spatial regression model of dependence of milk production (Y_x) on the number of cattle (X) developed according to data in the context of federal districts of Russia,[5] has the form:

$$Y_x = 116 + 1.55X.$$

The linear correlation index, equal to 0.861, indicates a fairly close relationship between indexes, and the regression coefficient means that with an increase on the number of cattle per 1,000 heads, milk production increases by 1.55 thousand tons. An assessment of regional location of this resource and its dynamics are actual [Table 9].[4,5]

For the period of 1990-2014, the most significant decrease of number of cattle occurred in the Central (78.4%), Northwest (79.5%), Urals (75.6%), and Far Eastern Federal Districts (76.6%).

Table 8: Composition of meat production (in slaughter weight) in Russia for 2010-2014

Index	Production, thousands tons		Dynamics (%)	Specific weight (%)	
	2010	2014		2010	2014
Cattle and poultry for slaughter (slaughter weight)	7167	9070	126,6	100,0	100,0
Including					
Cattle	1727	1654	95.8	24.1	18.2
Poultry	2847	4161	146.2	39.7	45.9
Pigs, sheep, goats, etc.	2593	3255	125.5	36.2	35.9

Table 9: Dynamics of the number of cattle in Russia for 1990-2014, thousand animals

Region	1990	2000	2010	2014	2014 in % to		
					1990	2000	2010
Russian Federation	57043.0	27519.8	19967.9	19374.5	34.0	70.4	97.0
The Central Federal District	13094.0	5527.4	2867.7	2833.6	21.6	51.3	98.8
The Northwestern Federal District	3253.8	1281.0	718.9	668.5	20.5	52.2	93.0
The Southern Federal District	9172.1	2438.3	2324.1	2298.1	50.2	94.3	98.9
The North-Caucasian Federal District		1818.0	2126.3	2305.8		126.8	108.4
The Privolzhsky Federal District	15268.2	8445.7	6143.0	5523.6	36.2	65.4	89.9
The Urals Federal District	3963.2	1897.1	1110.8	969.0	24.4	51.1	87.2
The Siberian Federal District	10582.2	5442.1	4219.8	4134.2	39.1	76.0	98.0
The Far Eastern Federal District	1709.0	670.3	457.3	399.3	23.4	60.0	87.3

If we consider a closer retrospective, it should be noted that the reduction in livestock numbers is almost suspended in the Central, Southern, and Siberian Federal Districts in 2010-2014. In the North-Caucasian Federal District, herd numbers increased by 8.4% during this period. Moreover, this is the only federal district where increase of livestock numbers has been achieved.

However, the unfavorable tendency to reduce the number of cattle was not overcome in three federal districts. In 2010-2014, the decrease of the number of livestock made: In the Privolzhsky Federal District – 10.1%, in the Urals – 12.8%, in the Far Eastern Federal District – 12.7%.

Reduction of the number of livestock affects limitation of development of processing industry which also affects provision of food security for the population.

Distribution of federal districts by the number of cattle does not match with their distribution among population. To quantify these differences, you can use localization indexes (i_{loc}):

$$i_{loc} = d_N/d_P$$

Where, d_N is the share of the region in the number of cattle; d_P is the share of the region in the number of population.

Indexes of localization show the extent to which the region's share in the number of livestock as an extensive resource for production of meat and dairy products does not coincide with the share of the region in the population as a subject of consumption of these products. In another way, the localization index can be interpreted as a relative degree of difference in provision of the population's demand for a certain resource of the j^{th} region from average provision for the country as a whole.[6,7]

With a certain degree of conventionality, we can assume that, in the context of this study, the localization indexes show a measure of regional differences in providing the population with a particular resource that ultimately affects consumption of specific food products, and hence food security.

Localization indexes calculated in Table 10 show a significant discrepancy in distribution of federal districts in terms of the number of cattle as a resource of meat and dairy products and the population as the main consumer of food products.[4]

The North-Caucasian, Siberian, Privolzhsky, and Southern Federal Districts are the most highly localized of livestock. In three of them, except Privolzhsky, there is an increase in localization of livestock for years 2010-2014. For example, in the North-Caucasian Federal District the localization index increased from 1.63 to 1.8. That is, at the end of 2014, the population of the North-Caucasian Federal District is provided with a resource of production of meat and dairy products 1.8 times higher than in the whole country. The lowest level of localization of the considered resource is characteristic for the Northwestern (localization index 0.36), Far-Eastern (0.49), Central (0.55), and Urals (localization index 0.59) federal districts. This means that for the population of these regions there is a high risk of lack of dairy and meat products produced in its territory.

A regional approach to the study of the problem of ensuring food security makes it possible to differentiate the effectiveness of measures of state support for agricultural production in certain subjects of the federation.

CONCLUSIONS

There are a number of factors of financial, climatic, technological, and social nature that have a negative impact onto development of agricultural production in the country. This emphasizes the importance of implemented measures of state support and initiatives of producers themselves and calls for further systematic approach on the part of the state in implementing programs to ensure food security of the country. Decrease of the number of cattle is an acute problem faced by the Russian Ministry of Agriculture. Although

Table 10: Accommodation of cattle number and the population of Russia in federal districts d 2010-2014

Federal District	Specific weight (%)				Localization index for	
	Cattle number		Population		2010	2014
	2010	2014	2010	2014		
The Central	14.4	14.8	26.8	27.0	0.54	0.55
The Northwestern	3.6	3.5	9.5	9.6	0.38	0.36
The Southern	11.6	12.0	9.7	9.7	1.19	1.24
The North-Caucasian	10.6	12.1	6.5	6.7	1.63	1.80
The Privolzhsky	30.8	28.9	21.0	20.7	1.47	1.40
The Ural	5.6	5.0	8.5	8.5	0.66	0.59
The Siberian	21.1	21.6	13.5	13.4	1.56	1.61
The Far Eastern	2.3	2.1	4.4	4.3	0.52	0.49

the industry has allocated substantial subsidies, existence of this problem indicates insufficient effectiveness of state support for agriculture in the country and absence of clearly established mechanism for implementing state programs.

Maintenance of economic accessibility of food for the population is impossible without increase of real incomes, for which it is necessary to increase employment of population and decrease inflation. As results of the research showed, the economic and physical accessibility of certain food products is not provided enough to affect the structure of consumption, energy, and nutritional value of diets negatively.

REFERENCES

1. Decree of the President of the Russian Federation of 30.01.2010 № 120 On Approving the Doctrine of Food Security of the Russian Federation. Official Site of the President of Russia. Available from: http://kremlin.ru/. [Last accessed on 2017 Apr 19].
2. Khramtsova TG. Problems of Assessing the Availability of Food for the Russian Population. Vol. 1. Novosibirsk Oblast: Bulletin Siberian University of Consumer Cooperatives; 2016. p. 72-8.
3. Russian Statistical Yearbook; 2014. Statistical collection. Moscow: Rosstat; 2014. p. 693.
4. Official Site of the Federal Service of State Statistics of Russia. Available from: http://www.gks.ru/. [Last accessed on 2017 Apr 19].
5. Single Interdepartmental Information and Statistical System. Available from: http://www.fedstat.ru/indicators/start.do. [Last accessed on 2017 Apr 19].
6. Glinskiy VV, Serga LK, Khvan MS. Environmental safety of the region: New approach to assessment. Procedia CIRP 2015;26:30-4.
7. Glinskiy V, Serga L, Chemezova E, Zaykov K. Clusterization economy as a way to build sustainable development of the region. Procedia CIRP 2016;40:324-8.

Source of Support: Nil. **Conflict of Interest:** None declared.